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The appropriation of $9,000,000 for improving the state canals of New York has been approved by popular vote, and the state officials at Albany are now discussing the issue of the bonds. The law makes $4,000,000 available at once, and these bonds will probably be placed on the market by Jan. 1, and within 90 days thereafter the work of improvement must be commenced upon the Erie, Champlain and Oswego canals. The bonds are not to bear more than 4% interest, and will run for a period not exceeding 17 years. The improvement contemplated includes deepening the Erie and Oswego canals to 9 ft., except over aqueducts, miter-sills and other permanent structures, where the depth is to be at least 8 ft.; lengthening and improving locks not yet lengthened; for boat-hauling machinery at locks; for retaining walls, etc. The Champlain Canal is to be deepened to 7 ft., and some retaining walls are to be built. All work is to be done by contract, let to the lowest bidder, and no one contract is to exceed the sum of $500,000.

A new Board of Trustees for the Sanitary District of Chicago was elected Nov. 5, which will have control of the work on the Chicago Drainage Canal for the next five years. The following men compose the Board: William Boldenweck, Bernard Eckhart, Frank Wenter, Thomas Kelley, Zina R. Carter, James P. Mallette, Joseph C. Braden, Thomas A. Smyth and Alexander J. Jones. Of the nine trustees, the first four named were re-elected from the old Board. The duties of these trustees were described in our issue of Oct. 3, and the important work of which they will have charge has already been made familiar to the readers of Engineering News by the series of descriptive articles which began in its issue of May 16, 1895. A particularly noticeable thing in the composition of this new Board is the fact that not one of its members is an engineer capable of appreciating the demands of the work from an engineering point of view.

The deepening of the Hudson to 12 ft., as far as the state dam, seven miles above Albany, will probably be completed within the next two years. The improvement projected and being carried out by the Federal Government calls for a channel 12 ft. deep and 400 ft. wide to the foot of Broadway, in Troy, and a channel 300 ft. wide, but of the same depth, to the state dam, at the head of navigation. Work is practically confined to the 30 miles between the dam and Coxsackie; below that point the Hudson has a natural depth of 12 ft. or more. The contracts for this work, let in 1893, cover the removal of 4,620,000 cu. yds. of earth and 190,000 tons of rock, and the building of eight miles of dikes. The estimated cost is $2,500,000. To this date, about 2,500,000 cu. yds. of earth and 65,000 tons of rock have been excavated. It would seem that a 26-ft. ship canal would be an expensive enterprise over this line, especially as it would demand work extending far below Coxsackie.

The opening of the Harlem Kills to navigation is being agitated, and Congress will be asked to make an appropriation for this purpose. This passage lies to the north of Randall's Island, and would connect the improved Harlem River, at New York, with Long Island Sound and avoid the long detour around Randall's and Ward's islands and through Hell Gate. Gen. John Newton, in his original survey for the Harlem ship canal, estimated the cost of making the Kills navigable, by dredging and rock removal, at $1,250,000. The petitioners claim that the improvement asked for would open up valuable water-front at Port Morris, where there is now from 30 to 50 ft. of water, and an average of from 15 to 20 ft. At present the Kills are so obstructed by rocks that it is only navigable to rowboats and very small sailing craft.

Work on the Chicago Lake Front Park improvement, which the Illinois Central R. R. Co. is to effect in conjunction with the city (Eng. News, Sept. 12), has been begun. The first work to be done is the construction of the sea wall, and the contractor for this is Hiero B. Herr & Co., of Chicago. As soon as 500 lin. ft. of the wall is built the city can begin to fill in the harbor behind it, and it is expected that much of the filling will be done without cost to the city by contractors on the Drainage Canal and new waterworks tunnel, who will be glad of the chance to get rid of their spoil in this easy manner. The 7,450 lin. ft. of sea wall is to be completed by June 1, 1896, according to the contract. This wall will be built of two parallel rows of piles 30 ft. apart c. to c., the piles of each row being held by waling on the inside and each pair of piles of opposite rows being tied together by 1⅛-in. screw bolts. Inside of each row of piles there is to be a lining of Wakefield sheet piling, and the space between these linings is to be filled with sand or clay. On the top of the filling there will be a cap of stone masonry from 2 ft. to 3 ft. thick. The contract price for the work is about $180,000.

Two timber caissons have been used for the foundations for columns in the new building for Siegel, Cooper & Co., at 19th St. and Sixth Ave., New York city, owing to trouble from water, etc. Considerable difficulty was found in sinking, due chiefly to a lot of sheathing, piling and timber left in place by contractors who had attempted to place the foundations, and failed in doing so. One of these caissons is situated at the northwest corner of the building, the other one in the center of the Sixth Ave. front. The latter foundation was placed within 5 ft. of some old dwelling houses and stores, without in any way disturbing them. The caissons were built of 12×12-in. yellow pine timber, and carried down to bed rock, at a depth of about 25 ft. The rock was found to slope considerably to the east, and it was necessary to blast and step it. Many bowlders were met and blasted in the sinking of the caisson. The work was completed within the specified time of 30 days from the commencement, including the building and sinking of the caissons, and the building of the base for the columns, consisting of about 10 ft. in depth of concrete, and 10 ft. in depth of brick pier. The work was done by Steers & Bensel, contracting engineers, 29 Broadway, New York city, under contract with the Seigel Construction Co. The architects are Messrs. De Lemos & Cordes.

The most serious train accident of the week was a head collision of a passenger and a freight train, Nov. 10, at Franklin, Tenn., on the Louisville & Nashville R. R. The freight train had orders to stop at West Harpeth, six miles from Franklin, but the engineman tried to reach Franklin. One man was killed and one fatally injured.——A passenger train on the Raritan River R. R. ran into the open drawbridge at South River, N. J., Nov. 6, the engineman having failed to see the red flag, on account of the fog. The engine and tender went into the water, and the engineman was hurt in jumping.

A locomotive boiler explosion occurred Nov. 10 near Warwick, N. J., on the Lehigh & Hudson R. R., by which two men were killed and two were fatally injured. The engine was hauling a freight train at the time. It is said that the engine was not an old one, and had been overhauled recently, but another report states that orders had been given not to carry a high steam pressure.

A northbound express train on the Great Northern Ry., of England, struck a freight train that was taking the siding at St. Neots, and the rear cars of the express were derailed. One person was killed and five were injured.

The steamer "Puritan," of the Fall River Line, went ashore on Great Gull Island, near New London, Conn., Nov. 9, a heavy fog prevailing at the time. The vessel was not got off until Nov. 12, but it is not thought the hull is seriously injured.——The British steamer "Irrawaddy," from Trinidad to New York, went ashore on the beach at Asbury Park, N. J., Nov. 9, owing to the fog.

The explosions of the two boilers of the "Detroit Journal" plant at Detroit, Mich., on Nov. 6, caused the collapse of the building and the loss of some 37 lives. The engineman stated that one boiler was carrying 60 lbs. of steam and the other 15 lbs., and he was getting up steam in the latter boiler at the time of the accident. The stop-valve in the steam pipe from this boiler was found closed. In this latter boiler the end seams had ripped apart, the shell flattening out, but there was also a crack across the top, through the solid metal of one of the ⅝-in. plates. The boiler inspectors who examined the wreck are reported as believing that the primary cause of the explosion was low water in this boiler. The other boiler was ripped at one of the seams, and had been driven forward into the wall of the building, thereby causing the collapse of the structure. The engineman was not seriously hurt, and is under arrest, it being claimed that he was in the habit of leaving his post to get a drink.

A break-out occurred in the blast furnace of the Clinton mill at Pittsburg, Pa., Nov. 8. The molten material flowed into a sewer and caused an explosion under the engine room, damaging the hoisting engine. The building caught fire, but the flames were extinguished by the fire department.

The report of an explosion of the boiler of a steam shovel used by the Canadian Pacific Ry. for ballasting on the Pasqua section, which was noted in our issue of Sept. 17, on the strength of press despatches, turns out to have been incorrect. Mr. Whyte, General Superintendent of the Western Division, states that a steam shovel was used on that section of the line for about two months, until business got so heavy that they could not spare the locomotives for construction purposes. This steam shovel is still in good working order, and no such accident ever occurred.

A strike of switchmen, machinists, carpenters, etc., was started Nov. 4 on the Great Northern Ry., by order of the American Railway Union, but does not appear to have been serious, although the strikers at once commenced acts of violence, ditching engines and cars, cutting wires, and setting fire to a trestle.

About 45 miles of macadamized road have been built in New Jersey during the fiscal year, according to a published statement by Mr. C. I. Budd, State Commissioner of Roads, and the state has paid $100,000 towards the cost of construction. About 35 miles are now under construction, and some counties are now advertising for bids for road work. It is said that about 60 miles of road will be built during the fiscal year 1895-96.

Karri wood paving blocks, from Australia, are to be tried on West 20th St., New York. Messrs. Marks and Tamperly, two Englishmen, have obtained permission to lay 1,000 sq. yds. of this pavement at their own expense. This wood is considerably used for street paving in London and Paris, and the parties named hope to further its introduction here.

Four boulevards are now under construction at Boston, forming suburban extensions of Commonwealth Ave., Huntington Ave., Columbus Ave. and Blue Hill Ave. The general arrangement includes sidewalks 10 ft. wide, separated by turfed spaces 5 ft. wide (on which trees are planted), and two roadways, 25 to 40 ft. wide, the roadways being separated by a central space 25 ft. wide, on which street car tracks will be laid. The arrangement varies somewhat in different parts, and in one part there will be a single 54-ft. roadway, with no central space. The total cost of the work will be about $2,770,000, and the work is being done under the supervision of Mr. Wheeler, Superintendent of Streets.

A fast run was made on the Chicago, Burlington & Quincy R. R., Nov. 11, a train making the run of 80 miles, from Galesburg to Mendota, in about 80 minutes.

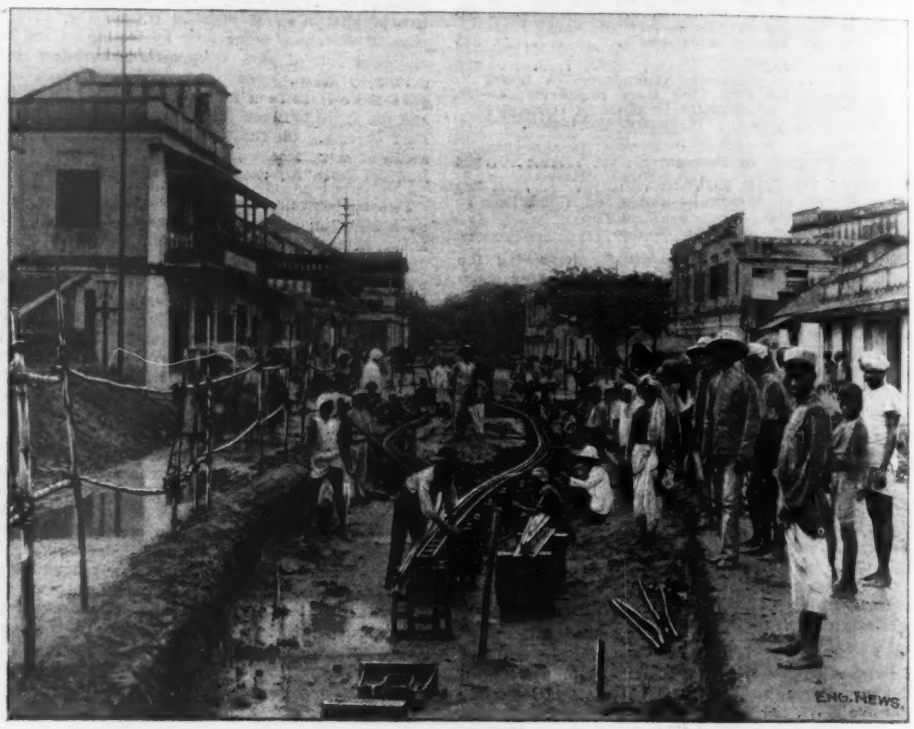
The piers for the Delaware River bridge, under construction for the Pennsylvania R. R. crossing at Philadelphia, have been completed one month ahead of contract time by the Drake & Stratton Co., contractors for this work. The six masonry piers, five of them in the river, aggregate in quantity 25,000 cu. yds. The contract was signed on Dec. 31, 1894, and the first caisson was sunk on March 1, 1895. The work was somewhat delayed by the washing away of three of the caissons, at different times, but under the contract the contractors have a handsome per diem premium for completing the masonry before Dec. 31, 1895.

The excessive flow in some of the sewers of Memphis, Tenn., has been remedied this year by the construction of a few short relief sewers along lines recommended by Mr. James H. Elliott, Engineer-in-Charge of Sewers. The relief sewers empty into the main outlets, and their construction has been followed by closing all "bleeders" into the bayou. This work was recommended by Mr. Elliott in his report for 1894, in which he gave in detail the methods by which he estimated the flow in the sewers. He assumed 20 persons tributary to each 100 ft. of sewer, and 80 gallons of sewage to be contributed by each person per day. The points needing relief and the amount of sewage to be provided for were thus obtained.

CONDUIT ELECTRIC RAILWAY AT MADRAS, INDIA.

The electric railway recently built at Madras, India, by the Madras Electric Tramways Co., is of interest not only on account of its being the first electric railway in India, but also on account of its being built on the conduit system. The line is 5¼ miles long, and will be 7 miles long when the extensions are completed. There are practically no grades. The conduit system is very similar to that of the well-known line at Budapest, Hungary, the slot being alongside one of the track rails. Small cast iron yokes are used, set in concrete, and the accompanying illustration represents the construction of the conduit at a turnout, or passing place. The outer rail is a grooved girder rail, as shown at the right of the view. The conductor is a T-rail, suspended by porcelain insulators.

The power house is a brick building, containing two Elwell & Parker dynamos of 500 volts, delivering 240 amperes at 430 revolutions per minute. There are two horizontal compound engines of 180 I. HP. at 120 lbs. pressure and 90 revolutions per minute, and connected by rope drives to the dynamos. Steam is supplied by two Babcock & Wilcox boilers, of 250 HP., carrying 120 lbs. pressure, and there is a Berryman feedwater heater. The motor cars are four-wheel open cars, with transverse seats, accommodating 36 passengers, and have 33-in. wheels, and 7-ft. wheelbase. The motors are of 10 HP., single reduction, with double helical steel gearing to the axle. There is a nine-minute service, and each car runs about 60 miles per day. It is said that as the fares are low, averaging about 1 ct. per mile, a good traffic is expected. Mr. C. Gadsby is the electrician. We are indebted to Mr. W. Lodian for the accompanying particulars, and for the photograph from which our illustration has been prepared.



CONSTRUCTION OF A CONDUIT ELECTRIC RAILWAY AT MADRAS, INDIA.

METHODS OF MEASURING HIGH TEMPERATURES.

During the past few years great advances have been made in the art of measuring high temperatures in metallurgical and other industrial operations, the records of which are scattered through numerous papers read before engineering societies and articles in the technical press, as well as in that fertile field of information, manufacturers' catalogues. We have been for some time collecting information from these various sources, and present herewith a condensed summary of the present state of the art of pyrometry with especial reference to several important forms of apparatus which have been recently developed.

Pyrometers may best be classified according to the principles upon which they operate. These principles are as follows:

1. Expansion of mercury in a glass tube. When the space above the mercury is filled with compressed nitrogen, and a specially hard glass is used for the tube, mercury thermometers may be made to indicate temperatures as high as 1,000° F.
2. Contraction of clay, as in the old Wedgwood pyrometer, at one time used by potters. This instrument was very inaccurate, as the contraction of clay varied with its nature.
3. Expansion of air, as in the air thermometer, Wiborgh's pyrometer, Uehling and Steinbart's pyrometer, etc.
4. Pressure of vapors, as in Bristol's recording pyrometer.
5. Relative expansion of two metals or other substances as in Brown's, Bulkley's and other metallic pyrometers, consisting of a copper rod or tube inside of an iron tube, or vice versa, with the difference of expansion multiplied by gearing and indicated on a dial.
6. Specific heat of solids, as in the copper-ball and platinum-ball pyrometers.
7. Melting points of metals, alloys, or other substances, as in approximate determination of temperature by melting pieces of zinc, lead, etc., or as in Seger's fireclay pyrometer.
8. Time required to heat a weighed quantity of water enclosed in a vessel, as in one form of water pyrometer.
9. Increase in temperature of a stream of water or other liquid flowing at a given rate through a tube inserted into the heated chamber.
10. Changes in the electric resistance of platinum or other metal, as in the Siemens pyrometer.
11. Measurement of an electric current produced by heating the junction of two metals, as in the Le Chatelier pyrometer.
12. Dilution of a stream of hot air or gas flowing from a heated chamber by cold air, and determination of the temperature of the mixture by a mercury thermometer, as in Hobson's hot-blast pyrometer.
13. Polarization and refraction by prisms and plates of light radiated from heated surfaces, as in Mesure and Noel's pyrometric telescope or optical pyrometer.

We will now describe some of the principal forms of pyrometer in which the above principles are exemplified.

Mercurial Thermometer with Compressed Nitrogen.—The ordinary mercurial thermometer is valueless above 600° F., since mercury boils at 675° F. and begins to vaporize at a considerably lower temperature in the vacuum of a thermometer. It has been found, however, that by filling the vacant space in the tube above the column of mercury with compressed nitrogen, the vaporization points of the mercury may be raised to 1,000° F. Thermometers on this principle are now made by Queen & Co., of Philadelphia, and by Hohmann & Maurer, of Brooklyn. Fig. 1 shows one of Queen's thermometers graduated to 800° F. The delicate glass tube is made of specially annealed glass from Jena, Germany. It is enclosed in a heavy brass case with a glass front. The scale case is usually made 15 ins. long and the lower tube 3 ft. long, but may be made longer or shorter if desired. The bulb is placed in a metal chamber, to protect it from jar and dirt, and the lower part of the brass tube is perforated to allow free access for the hot gases or liquids to the metal chamber which protects the bulb.

The Metallic Pyrometer.—A form of pyrometer long used for measuring temperatures not exceeding 1,200° to 1,500° F. is the well-known copper and iron tube pyrometer made by H. W. Bulkley and Schaeffer & Budenberg, of New York; Edward Brown and Queen & Co., of Philadelphia, and others. It is based on the principle of the difference of expansion by heat of copper and iron tubes or rods. An iron tube is encased loosely in a copper tube, or vice versa, the two being connected at one end. At the other end the exterior tube is connected to the casing of a graduated dial and the inner tube to a multiplying gear, which multiplies the relative motion of the free ends of the tubes and moves a rotating pointer on the dial. The stem is usually made 36 ins. long, but other lengths are made to order.

In order to ensure correct indications with this instrument, the tube, or stem, must be exposed to the heated gas or liquid throughout its length. These pyrometers have the peculiarity when first exposed to the heat that the pointer will run rapidly either forward or backward, depending upon which metal is on the outside, which is due to the outside tube being heated before the inside tube is affected. When the whole stem becomes thoroughly heated after a little while, the pointer will find its proper place and indicate the temperature as correctly as the nature of the instrument will admit. Should the pointer after the pyrometer has been in use, not come back to the temperature of the atmosphere, which may be the case where high temperatures have been measured, changing somewhat the nature of the metal, the pointer should be readjusted by applying a key or screw-driver to the adjusting arrangement in the side of the case.

Metallic pyrometers are usually standardized by immersing them in a tube of steam, the temperature of which is known from its pressure, up to, say, 350° F., and by superheated steam or boiling oil, the temperatures of which are determined by a mercury thermometer up to about 600° F. Beyond these temperatures the dial is graduated proportionally, it being assumed that the coefficient of expansion at all temperatures within the range of the instrument is constant, which, however, is by no means certain. On account of the changes in the normal length of the metals, which are apt to take place after repeatedly subjecting them to high temperatures, these pyrometers should be occasioally restandardized. In any case, the indications of this class of pyrometers should be considered only as approximate measurements of actual temperature, and should be checked by more accurate instruments in all cases where accuracy is desired.

Bristol's Recording Thermometer.—This ingenious instrument gives a continuous graphical record of temperatures up to 600° F. It consists, as shown in Fig. 2, of a copper coil, which takes the place of a bulb, and is inserted in the heated space. The bulb is partly filled with alcohol, which is partly vaporized by the heat. The pressure of

the vapor is transmitted through a fine flexible copper tube, filled with alcohol, to any convenient distance, not exceeding 25 ft., where it is measured by a recording pressure gage similar to those used in the Bristol recording steam gage. The interior of the gage is shown in Fig. 3. It consists of a flat Bourdon spring, coiled into three complete coils. The movable end of the spring carries a pointer, which contains an inking pencil at its outer end. The motion of the pointer is so great that no multiplying devices are needed, as in the ordinary Bourdon pressure gage. The clockwork revolves a paper chart once in 24 hours, and the marker thus makes a continuous record. The scale on the gage chart is graduated in degrees Fahrenheit by means of a standard thermometer. The coil, D, is immersed in oil for standardizing in connection with the graduating chart.

Fig. 1. Queen's Mercurial Pyrometer.

Fig. 4. Diagram of Scale.

There is no compensation required for changes of temperature in the room where the recorder is placed, as the small copper tube is completely filled with alcohol, and the pressures due to given temperatures are always the same.

Fig. 4 shows a specimen section from a chart of one of these thermometers for a range of 270° F.

The bulb end of the instrument may be made straight instead of coiled, so that it may be put into a closed pipe with stuffing box, to measure temperatures of steam, etc.

The upper limit of the instrument is fixed by the fact that as the temperature increases the pressure increases in much greater ratio, and at a temperature of 600°. or so becomes so great as to be unmanageable.

The Air-Thermometer.—The final standard of reference for all determinations of temperature above 212° F. has for many years, and probably will long continue to be the air-thermometer, and pyrometers of all kinds are referred to it as a standard whenever an approach to scientific accuracy is desired. Air at constant pressure expands 1-492 of its bulk for every increase of 1° F. in its temperature, and this principle, together with the law that the pressure varies inversely with the volume, forms the basis of a great variety of forms of air-thermometer. The most common forms were described and illustrated by Prof. R. C. Carpenter in Engineering News of Jan. 5, 1893, and from that article we make the following brief extract:

> Air is a perfect thermometric substance, and if a given mass of air be considered, the product of its pressure and volume divided by its absolute temperature is in every case constant. It follows from this that if the volume of air remain constant, the temperature will vary with the pressure; if the pressure remain constant, the temperature will vary with the volume. As the former condition is more easily attained, air thermometers are usually constructed of constant volume, in which case the absolute temperature will vary with the pressure.
>
> If we denote pressure by p and p^1, and the corresponding absolute temperatures by T and T_1, we should have
>
> $$p : p^1 : : T : T_1 \text{ and } T_1 = p^1 \frac{T}{p}.$$
>
> The absolute temperature T is to be considered in every case 460° higher than the thermometer reading expressed in Fahrenheit degrees. From the form of the above equation, if the pressure p corresponding to a known absolute temperature T be known, T_1 can be found. The quotient $\frac{T}{p}$ is a constant, which may be used in all determinations with the instrument. The pressure on the instrument can be expressed in inches of mercury, and is evidently the atmospheric pressure, b, as shown by a barometer, plus or minus an additional amount, h, shown by the manometer attached to the air thermometer.
>
> That is, in general $p = b \pm h$.
>
> The temperature of 32° F. is fixed as the point of melting ice, in which case T = 460 + 32 = 492° F. This temperature can be produced by surrounding the bulb with melting ice, and leaving it several minutes, so that the temperature of the confined air shall become the same as that of the surrounding ice. When the air is at that temperature, note the reading of the attached manometer, h, and that of a barometer; the sum will be the value of p corresponding to the absolute temperature of 492° F. The constant of the instrument, $K = 492° \div p_1$ once obtained can be used in all future determinations.

Another description and illustration of an air thermometer, by Mr. J. C. Hoadley, may be found in "Trans. Am. Soc. Mechanical Engineers," Vol. VI., p. 282.

An air pyrometer, designed by Messrs. A. Siegert and W. Duerr, consists of a porcelain bulb connected by a thin copper tube with the measuring portion of the apparatus. This consists of a bell of sheet brass, the lower edge of which dips into a bath of petroleum. This bell is attached to one arm of a balance beam, a counterpoise being carried by the other arm. The porcelain bulb being heated to the temperature to be measured, the air it contains expanding enters the brass bell, lifting this and moving the beam. The movement is shown on a scale, and the temperature read direct from the divisions, into which this scale is divided. —"Journal of the Iron and Steel Institute," 1893, No. 2, p. 340.

The Wiborgh Air Pyrometer.—This pyrometer was described and illustrated in a paper by Emanuel Trotz in the "Transactions of the American Institute of Mining Engineers," Vol. XXI., p. 592. Its construction is based upon the following theory:

If an air volume, V, enclosed in a porcelain globe and connected through a capillary pipe with the outside air, be heated to the temperature T (which is to be determined), and thereupon the connection be discontinued, and there be then forced into the globe containing V another volume of air V′ of known temperature, t, which was previously under atmospheric pressure H, the additional pressure, h, due to the addition of the air volume V′ to the air volume V can be measured by a manometer. But this pressure is, of course, a function of the temperature T. Before the introduction of V′, we have the two separate air volumes, V at the temperature T, and V′ at the temperature t, both under the atmospheric pressure H. After the forcing in of V′ into the globe, we have, on the contrary, only the volume V of the temperature T, but under the pressure H + h.

The temperature T is then obtained from the following equation:

$$T = \frac{V\,h - V'\,H}{V'\,a\,H} + \frac{h\,V}{V'\,H\,t},$$

in which a is the expansion coefficient of air, as determined by the experiments of Gay-Lussac, Dulong, Rudberg and Regnault. In the instrument described by Mr. Trotz the pressure is registered by a manometer spring, which, by suitable gearing, causes a pointer to move upon a graduate dial.

Wiborgh's pyrometer is also described in the "Journal of the Iron and Steel Institute," 1888, No. 2, p. 110, and 1891, No. 2, p. 130.

Hobson's Hot Blast Pyrometer.—This instrument, shown in Fig. 5, is used for measuring the temperature of the blast in hot-blast iron furnaces. It mixes or dilutes the hot blast with a certain proportion of air at ordinary atmospheric temperatures, and indicates the temperature of the mixture by a mercury thermometer.

It consists of a brass chamber having three arms and a handle. An opening through a jet in one of the arms admits the hot blast, another arm admits the atmospheric air, while the third arm is for the discharge of the mixture. To this third arm is attached a thermometer, which indicates

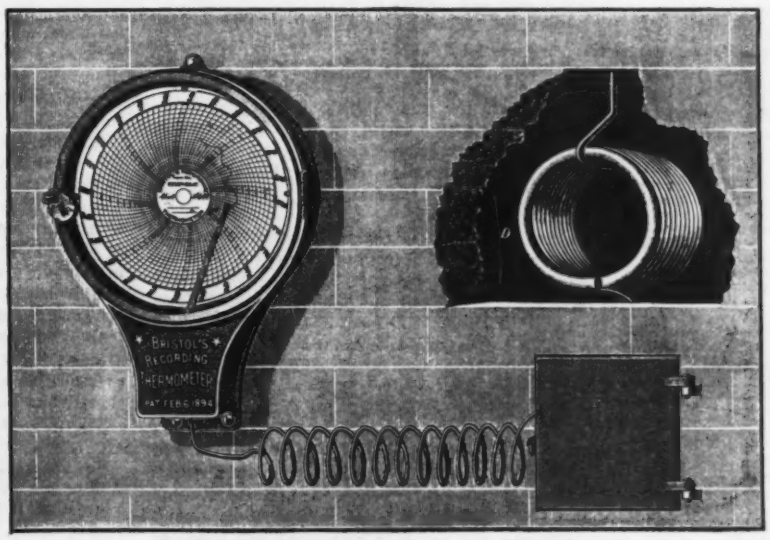


FIG. 2. BRISTOL'S RECORDING THERMOMETER.

Inside View of Gage. Fig. 3.

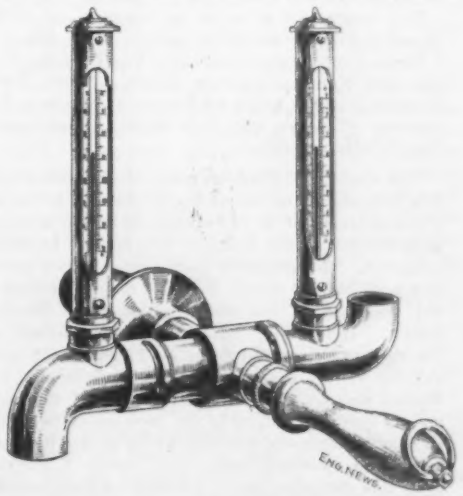


Fig. 5. Hobson's Hot Blast Pyrometer.

the temperature of the mixed current, and also the temperature of the hot blast. A thermometer is also attached to the arm admitting the atmospheric air.

The sizes of the hot blast inlet and of the air inlet are fixed so that the proportion of hot blast to the atmospheric air is always the same.

It has been found by experiment that the variation in the pressure of the hot blast will cause a corresponding variation in the quantity of air induced, so that the indications may be relied upon as correct.

This pyrometer can be used constantly to 2,000° F. without danger of injury. Its price, according to Queen & Co.'s catalogue, is $50.

Seger's Fire Clay Pyrometer.—Mr. H. M. Howe describes this pyrometer in the "Engineering and Mining Journal" of June 7, 1890, as follows:

Professor Seger uses a series of slender triangular fire-clay pyramids, about 3 ins. high, and ⅝ in. wide at the base, and each a little less fusible than the next These he calls "Normal Pyramids" ("normal-kegel"). When the series is placed in a furnace whose temperature is gradually raised, one after another will bend over, as its range of plasticity is reached, and the temperature at which it has been bent, or "wept," so far that its apex touches the hearth of the furnace or other level surface on which it is standing, is selected as a point on Seger's scale. These points may be accurately determined by some absolute method, or they may merely serve to give comparative results. Unfortunately, these pyramids afford no indications when the temperature is stationary or falling.

The Mesure and Nouel Pyrometric Telescope, or Optical Pyrometer.—This instrument is thus described by Mr. H. M. Howe in the "Engineering and Mining Journal" of June 7, 1890:

Mesure and Nouel's pyrometric telescope gives us an immediate determination of the temperature of incandescent bodies, and is, therefore, much better adapted to cases where a great number of observations are to be made, and at short intervals, than Seger's. Such cases arise in the careful heating of steel. The little telescope carried in the pocket, or hung from the neck, can be used by foreman or heater at any moment.

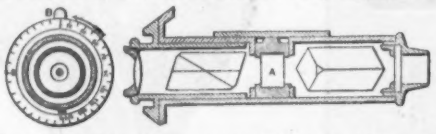


Fig. 6 Optical Pyrometer of Nouel and Mesure.

It is based on the fact that a plate of quartz, cut at right angles to the axis, rotates the plane of polarization of polarized light to a degree nearly inversely proportional to the square of the length of the waves; and, further, on the fact that while a body at dull redness merely emits red light, as the temperature rises, the orange, yellow, green and blue waves successively appear.

If, now, such a plate of quartz is placed between two Nicol prisms at right angles, "a ray of monochromatic light which passes the first, or polarizer, and is watched through the second, or analyzer, is not extinguished as it was before interposing the quartz. Part of the light passes the analyzer, and to again extinguish it, we must turn one of the Nicols a certain angle," depending on the length of the waves of light, and hence on the temperature of the incandescent object which emits this light. Hence the angle through which we must turn this analyzer to extinguish this light is a measure of the temperature of the object observed.

The instrument is made by Ducretet, of Paris; Queen & Co., Philadelphia, agents. Price, $35.

The accompanying illustration, Fig. 6, of the Mesure and Nouel pyrometer is taken from Prof. Roberts-Austen's paper on Recent Advances in Pyrometry ("Trans. Am. Inst. Mining Engineers," Vol. XXIII., p. 435).

The Cornu-Le Chatelier Optical Pyrometer.—In this instrument the estimation of elevated temperature is determined by the utilization of the absolute measurement of the intensity of a specific luminous radiation. The difficulty that occurs in the use of this principle for closely accurate determinations is the variation of the emissive power of different bodies. It is pretty certain that the intensity of the radiations emitted from an incandescent body are not merely dependent on its temperature, but depend also on the particular nature of the body and its surface; but, as in the instance of two such strikingly physically different bodies as are iron and brick the emission factor only varies 1-10,000th part, this difficulty for all industrial determinations can safely be ignored. The Cornu pyrometer has been adopted by M. Le Chatelier, and enables a perfect comparison to be made between the incandescent object (whose temperature is to be determined) and the luminosity of the flame of an acetate of amyl lamp. A description of the instrument and of the method of standardizing it will be found in the "Journal of the Iron and Steel Institute," 1892, No. 1, pp. 196 and 211.

The Copper Ball or Platinum Ball Pyrometer.—If a weighed piece of metal, such as iron, copper or platinum, be allowed to remain in a furnace or heated chamber till it acquires the temperature of the chamber, and then be suddenly taken out and immersed in a vessel containing a quantity of water of known weight and temperature, the resulting increased temperature of the water may be used as a measure of the temperature of the ball when it was withdrawn from the furnace. Let W = the weight of the water, w = weight of the ball, t = the original and T the final temperature of the water and S the specific heat of the metal, then the temperature of the heated chamber may be found from the following for formula be found from the following formula:

$$x = \frac{W\,(T - t)}{w\,S} + T.$$

In practice with this method many precautions are required. The metal ball should be enclosed in a small crucible, or other casing, while in the furnace and until the instant that the ball is dropped into the water, in order to avoid loss by radiation during the transfer from the furnace to the water; the water should be stirred rapidly, in order to cool the ball as quickly as possible, and to avoid errors in reading the temperature of the water; the "water equivalent" of the heat-carrying capacity of the vessel containing the water should be carefully determined and added to the actual quantity of water used, to obtain the corrected value of W in the formula. Finally, for scientific determinations, the actual specific heat of the metal ball should be carefully determined. The specific heat of metals generally increases with the temperature; thus the specific heat of wrought iron, according to Petit and Dulong, is .1098 from 32° to 42° F., and .1255 from 32° to 662° F. The specific heat of copper is .094 from 32° to 212° F., and .1013 from 32° to 572° F. The mean specific heat of platinum between 32° and 446° F. is .03333, and it increases .0003 for each increase of 100° F. Those desiring to use the platinum ball method of determining high temperatures should consult the description of one given in a paper by J. C. Hoadley in "Trans. Am. Soc. M. E.," Vol. VI., p. 702. Mr. Hoadley describes, among other things, the use of a compound ball made of wrought iron with a platinum casing, which is much less expensive than a ball made wholly of platinum.

Professor R. C. Carpenter, of Cornell University, prefers a ball of fireclay to one of copper or platinum. It does not lose as much heat in transferring as a metal ball, and it gives very uniform results.

The Circulating Water Pyrometer.—Mr. Carl Barus, in Bulletin No. 54 of the U. S. Geological Survey, refers to this pyrometer as follows:

The circulating water pyrometer, due to Boulier and others, in which the heat passing by condensation into the explorer or measuring part of the instrument, is carried off by a current of water flowing between known levels, seems to be gaining in favor. The thermal estimate is made by measuring the temperature of the water before entering and after leaving the furnace. The indications are, of course, wholly empiric. M. Boulier's compact and ingenious apparatus, the explorer, is a cylindrical box, with internal cylindrical partitions so adjusted as to secure a flow of water in cylindrical sheets. Water enters the outer compartment and leaves the inner, thus avoiding loss by radiation. This apparatus is used with great success in porcelain furnaces. Carnelly prefers a spiral explorer.

A water-current pyrometer, invented by Carnelley and Burton, is described and illustrated in "Grove's and Thorp's Chemical Technology," Vol. I., p. 342.

The Siemens Electric Pyrometer.—The principle of this pyrometer is as follows: A divided current passes from a battery to a platinum wire coiled round a clay cylinder and to a resistance coil. At the ordinary temperature the resistance of the platinum coil is balanced by a standard resistance. If, however,the platinum coil be heated,its resistance will be increased, and this increase, which can be measured in various ways, indicates the temperature of the coil. A committee of the British Association reported concerning the Siemens pyrometer that it was liable to changes of its zero, but Mr. H. S. Callendar ("Proc. Royal Society," Vol. XI., 1886, p. 566), showed that with proper precautions it might be made trustworthy. He wound the platinum wire on a plate of mica, and excluded reducing gases by enclosing the coil in a tube of double glazed porcelain. The thermo-electric pyrometer of Le Chatelier, however, has practically supplanted the Siemens pyrometer, at least for the present.

Mr. H. A. Callender's electrical resistance pyrometer is described in his paper on "Platinum Pyrometers" in the "Journal of the Iron and Steel Institute," 1892, No. 1, p. 164. For indication of the resistance he uses a modified Wheatstone bridge. He claims that with this instrument it is possible to read with certainty to 0.1° at 1,000° C. and that readings are actually constant and consistent to the fraction of a degree.

Le Chatelier's Thermo-Electric Pyrometer.—When wires of two dissimilar metals or alloys are placed in contact with each other and highly heated at the point of contact, an electric current is generated, the strength of which varies with the temperature, and may be indicated by a galvanometer. The La Chatelier pyrometer is based on this principle, and it consists, as manufactured by Queen & Co., of a thermo-electric couple of two wires, one of pure platinum and the other of platinum alloyed with 10% of rhodium, and a D'Arsonval galvanometer. The couple is inserted into the furnace or oven whose temperature is to be measured, and the current is led by wires to the galvanometer placed at any convenient distance from the couple. The instrument is capable of measuring very high temperatures, almost approaching the melting point of platinum.

It is almost instantaneous in its indications, five seconds being sufficient time to subject the couple to any stationary temperature; or the couple may, if desired, be left permanently in the furnace or oven, indicating at all times the temperature. The metals which compose the couple are not affected by gases, and hence will not become oxidized or react chemically on each other at high temperatures. They are, however, subject to change, due to repeated heating, so that recalibration is occasionally needed.

The measurement of the temperature is made by

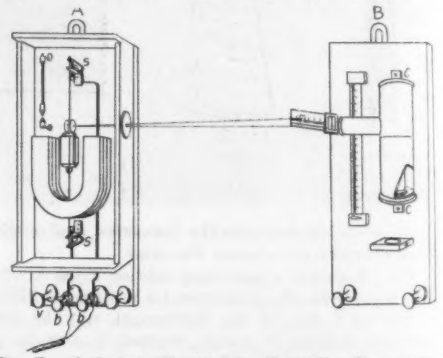


Fig. 7. Galvanometer for Le Chatelier Pyrometer.

means of a D'Arsonval galvanometer, contained in two wooden boxes, which may be screwed against a wall or slab about 1 in. apart, as shown in Fig. 7. The box A contains the galvanometer proper and is also provided with set screws and a small plumb bob, so that it may be set vertically. Box B contains the lamp, having a lens and window with cross hairs for throwing an image upon the galvanometer mirror in box A, which in turn reflects it back upon the scale in box B.

The current set up by the thermo-electric couple enters the galvanometer through the two binding posts in box A, and is reflected upon the scale in box B. The scale is graduated in millimeters, and it is necessary, therefore, that a curve be made reducing these millimeters to degrees Fahrenheit or Centigrade. This curve is very simply made from the following known melting points: Water boils, 212° F.; lead melts, 617° F.; zinc melts, 779° F.; gold melts, 1,913° F.; palladium melts, 2,732° F. The list price of the Le Chatelier pyrometer, as given by Queen & Co., is $140. Mr. Henry M. Howe, President of the American Institute of Mining Engineers, at the meeting of the Institute in February, 1894, said that he had used the Le Chatelier pyrometer for several years with great

satisfaction. He says it is certainly a most convenient and accurate instrument for the laboratory, and one that may be used under some conditions in the mill. For accuracy the position of the zero point should be determined frequently, as it is very liable to shift from a number of causes, which Mr. Howe mentions. Those intending to use the Le Chatelier pyrometer should consult Mr. Howe's remarks in "Trans. A. I. M. E.," Vol. XXIV., p. 746; also the paper of Prof. Roberts-Austen, "Trans, A. I. M. E.," Vol. XXIII., p. 107, in order to inform themselves of certain precautions which should be observed in the use of the instrument. The research of Mr. Carl Barus, published in Bulletin No. 54 of the U. S. Geological Survey, also contains much valuable information on the subject.

The Simonds Thermo-Electric Pyrometer.—A thermo-electric pyrometer, manufactured by Messrs. A. A. Simonds & Son, of Dayton, O., is described in the "American Machinist" of Oct. 17, to which paper we are indebted for the cut, Fig. 7a. It

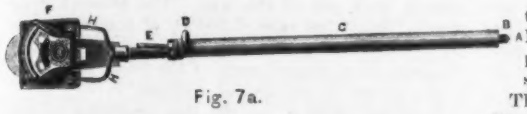


Fig. 7a.

has been used with great satisfaction in steel-tempering furnaces. At A are two small wires which project slightly from a ½-in. tube. One of these wires is platinum and the other an alloy of platinum. They connect with copper wires which pass on through the tube, and are seen at H H. where they are connected with a galvanometer.

The ½-in. tube through which the wires pass is encased in a 1¼-in. pipe, which serves as a water jacket, water entering by the tube E, through which it passes to a point near the other end, and is discharged into the jacket, through which it then circulates to the outlet, D. Thus, only the short platinum wires are heated, the rest of the instrument being cool.

The galvanic current generated by the heated wires passes through the copper wires to the galvanometer, and thus indicates the temperature, and it is found that, so long as the current of water is maintained, any temperature below the melting point of platinum (over 3,000° F.) will be continuously indicated and can be accurately observed.

Since in accurate work the temperature of the room must be taken into consideration, a simple table is prepared, by which galvanometer readings can be readily corrected. The pipe, C, is inserted in the furnace so that the wires enter the heated chamber, and the only requirements are a 1¾-in. hole through into the furnace and a small, constant stream of water. The instrument is ordinarily about 4 ft. long, but can be made longer or shorter to suit conditions.

Howe's Proposed Pyrometer for Furnaces.—Mr. H. M. Howe ("Trans. Am. Inst. Mining Engineers," Vol. XXIV., p. 802) suggests a new form of pyrometer, in which the heat radiated from the furnace through an opening in its walls is caused to pass through a plate of rock salt or glass and strike the bulb of a mercury thermometer, which is placed in a chamber whose walls are kept at a uniform temperature. What Mr. Howe calls his first approximation in the design of such a pyrometer is shown in Fig. 8 and is thus described:

Within the water-jacketed box, D, stands the high temperature thermometer or its equivalent, E. On the bulb of this the heat radiated from the interior of the furnace strikes after passing through the water-jacketed tube, C, and through the diathermic plate, G. As the temperature of the furnace rises and falls, so the amount of heat which would be radiated from the furnace upon G would increase or diminish, and so would the quantity of heat which would strike on the bulb, E.

In order that no variable other than the quantity of heat radiated from the furnace upon E shall influence the temperature of the latter, we must guard against convection currents, and we must make the temperature of the walls of the tube C and of the vessel D constant. This we can readily do by water-jacketing them as I have shown, and by keeping their temperature constant by means of a stream of cooling water regulated by the cock B, and the thermometer A. The convection currents we should prevent by means of a diathermic plate, G. The ideal substance of which to make this would be rock salt, on account of its high diathermancy. But it may not be practicable

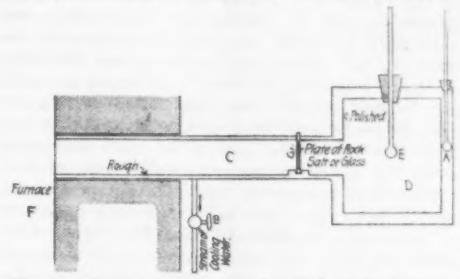


Fig. 8. Suggested Design for Howe's Radiation Pyrometer.

to get and maintain suitable pieces of salt. For most cases a very thin sheet of glass would probably do, though mica, smoky quartz, and several other minerals suggest themselves.

This apparatus would give relative results, but its indications may be calibrated so as to give absolute temperatures, by once for all determining the temperature of the furnace independently by and recording the temperature of the hot blast used in smelting iron. By a slight modification of the fire tube—i. e., the part exposed to the temperature to be measured, it can be adapted to meet the requirements of glass works, annealing furnaces, porcelain works, gas works, enameling works, etc.

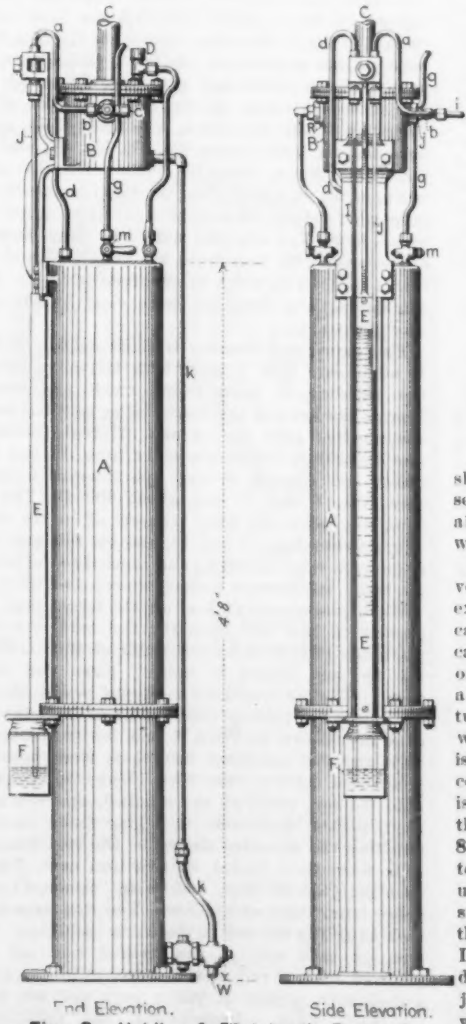
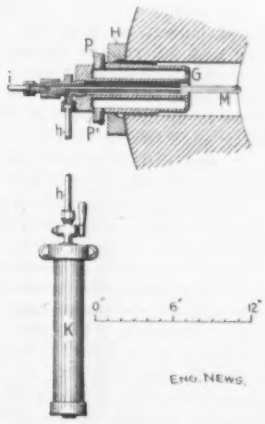


Fig. 6. Uehling & Steinbart's Pyrometer.

The pneumatic pyrometer is based on an ingenious application of the law of flow of gas through small apertures. Briefly stated, if two such apertures form respectively the inlet and outlet openings of a pipe or chamber, and air be some other pyrometer, such as Le Chatelier's.

Uehling & Steinbart Pneumatic Pyrometer.—This instrument, in the form herewith illustrated, is designed especially for continuously indicating caused to flow through such apertures and chamber, then the tension in the chamber will be intermediate between the tension of the air before entering and after leaving the chamber, and this tension will remain constant as long as there occurs no change of temperature in the air as it flows through the apertures, and no change in the difference of tension between the inflowing and outflowing air. If this condition of tension be maintained—i e., if the air be drawn through the instrument by a constant suction (or constant pressure), and the temperature at which the air flows through one of the apertures is also kept constant, then the tension of the air in the chamber between the apertures will vary with the temperature at which it flows through the other aperture.

Practical application of the above principles is made in the pneumatic pyrometer. Fig. 9 is a side and Fig. 10 a front elevation of the instrument. Fig. 11 shows the fire-tube in connection with a hot-blast main of a blast furnace. Fig. 12 is a filter for purifying the air to prevent the obstruction of the small apertures by particles of dust, etc. The fire-tube, M, Fig. 11, projects into the space, the temperature of which is to be indih into the fire-tube M, in which it is heated to the temperature to be measured, and at this temperature it enters the small aperture at the end of the inner tube, thence by way of i j into a coil (not



shown) located in chamber B, thence through the second aperture, located in the coupler R, into the air space above the water in the vessel A, from which it is continuously drawn by the aspirator D.

A pipe, open at both ends (not shown), enters the vessel A from the top, and dips into the water exactly 48 ins. The aspirator is made of a greater capacity than can be supplied through the small cated. It consists of a platinum tube, closed at one end and having placed concentrically within it a smaller platinum tube, which has a small aperture at its end. The connection of the fire-tube with the other pipes, which are of drawn copper, is protected against injury from the heat by the cooler, G, held in position by the flange, H, and is provided with water circulation by means of the pipes P P'. The vessel A, 4 ft. 8 ins. high and 8 ins. internal diameter, and filled with water to within 6 ins. of the top, serves as a suction regulator, and the vessel B, into which the exhaust steam of the aspirator D is discharged, serves as the temperature regulator. Two manometer tubes, I and J, are fastened in front of the scale E, and dip into the liquid (colored water) contained in the jar F. The tube I connects through the pipe d with the top of the regulator A, and shows the amount of suction, as at I'. The tube J connects by the tube a at b with the space between the two small apertures, one of which is located in the end of the inner fire-tube, and the other in the coupling, R, just within the vessel B. A water

connection is provided, by which the vessel A may be filled to the proper level.

The instruments operate as follows: Steam being turned on the aspirator, D, a partial vacuum is at once created in the apparatus. In consequence, atmospheric air enters the bottom of the tube K (Fig. 12), which, being filled with cotton, cleanses the air from all dust, etc., and allows it to pass in a pure state through the connecting tube apertures, the deficiency being drawn through the tube just described against the constant water column of 48 ins.; this insures a perfect and automatic regulation of the suction, which is always shown by the manometer I, at I'. If the water column in A, in consequence of gradual evaporation, sinks, it will at once show at I', and can be replenished by simply opening the cock at M until I' comes to the exact mark.

The aspirator D exhausts into the vessel B, and from there through C into the atmosphere; the water of condensation drains off by the pipe K into the waste pipe W. By this expedient the temperature in B is constantly kept at 212°, and as the air passes through a coil located in B, it must assume this temperature before passing through the second aperture.

Having thus secured, first, a constant difference of tension of the air before entering the first aperture and after leaving the second aperture, and also a constant temperature at which it passes through the second aperture, the tension between the two apertures must necessarily vary with the temperature of the air entering through the first aperture, which is located at the end of n. The manometer, J, communicating with the tube or chamber between the two apertures through the pipe n, indicates the temperature surrounding the fire-tube, and can be read off on the scale E E at J', for example. The connecting pipe, l, may be several hundred feet longer, so that the main instrument, Figs. 9 and 10, can be placed in a convenient place a considerable distance away from the hot-blast main, furnace, etc. (Fig. 11), the temperature of which is to be measured. A Bristol autographic recording gage (shown in Figs. 2 and 3) is attached at c, and can be placed in close proximity to the main instrument, A, or in any other convenient place. It is furthermore quite feasible to attach several manometers, with temperature scales, so that the heat can be read off at more than one point, if that be desirable or necessary.

Another feature of the pneumatic pyrometer is that it will correctly indicate the temperature of a space as small as ½ in. square by 2 ins. long. This instrument has been tested up to 2,500° F. by Prof. J. E. Denton, of the Stevens Institute of Technology, being exposed to that temperature for six consecutive hours at a time on ten different occasions, and has frequently been exposed to 2,700° F. without injury in practice. The instrument is now in successful operation at a large number of blast furnaces.

The pneumatic pyrometer is manufactured by Messrs. Uehling, Steinbart & Co., 61 Mulberry St., Newark, N. J.

TRACKLAYING ON THE MINNEAPOLIS, ST. PAUL & SAULT STE. MARIE RY. IN 1893.

(With Inset.)

We give on our inset sheet illustrations of the train and methods of work employed in 1892-1893 in the construction of the extension of the Minneapolis, St. Paul & Sault Ste. Marie Ry., from Valley City, N. Dak., northwest across North Dakota, 263 miles, to connect with a branch line which the Canadian Pacific Ry. was then building southeast from Pasqua (on the main line) to the United States boundary, 160 miles. In 1892 the contract for the construction was let to Linton & Co., of Minneapolis, and by the end of the season of that year the track had been laid from Valley City to Cathay, 80 miles. The line crosses a branch of the Northern Pacific Ry. at Carrington, and the Great Northern Ry. at Minot. The total length of the line from Valley City to Portal (on the boundary) is 263 miles. From Valley City the line follows the valley of the Sheyenne River for a few miles to Ivan. At Velva, 160 miles, it strikes the Mouse, or Souris River, and follows its valley beyond Minot to Burlington, where it enters the branching valley of the Riviere des Lacs, and follows this as far as the lakes, when it strikes across the prairie to Portal. The average amount of earthwork was about 19,000 cu. yds. per mile. The heaviest work was in the valley of the Des Lacs River, averaging 25,000 sq. yds. of earthwork throughout, and amounting to 50,000 cu. yds. per mile near the lakes. After leaving the bluffs beyond the lakes the work was comparatively light across the prairie, but was not kept less than 10,000 cu. yds. per mile, it being considered that with anything less than this the grade cannot be kept sufficiently above the prairie to prevent trouble from snow.

Work was commenced early in the spring, and tracklaying, which was not commenced until late in May, was completed by Aug. 25. There were some delays on account of grading and bridging, but they were not serious. This connection with an American railway gives the Canadian Pacific Ry. a second trans-continental route, leaving its main line at Sudbury, Ont., and going by way of Sault Ste. Marie, Minneapolis and Portal, joining the main line again at Pasqua. The distance from Sudbury to Pasqua is 1,371 miles by the C. P. Ry. main line, and 1,386 miles by the "Soo" line. For the information and drawings relating to the tracklaying train and work, we are indebted to Mr. W. W. Rich, M. Am. Soc. C. E., Chief Engineer of the Minneapolis, St. Paul & Sault Ste. Marie Ry.

The track is laid with 30-ft. rails, weighing 72 lbs. per yd., spiked to cross-ties 6 ins. thick, 7 to 10 ins. wide and 8 ft. long, spaced at the rate of 2,816 to 2,992 per mile, or 16 to 17 per rail length. The rails have square three-tie supported joints, spliced by 40-in. angle bars with six ⅞-in. bolts, spaced 6, 6½, 7, 6½ and 6 ins. c. to c. The engineer did not approve of this joint, and doubts the utility of any splice bar exceeding 22 to 26 ins. in length. This type of joint resembles that of the Canadian Pacific Ry. track, which has 44-in. splice bars and six bolts spaced 9¾, 6½, 5¼, 6½ and 9¾ ins. (Eng. News, Jan. 19, 1893). On the older track, south of Valley City, the Soo Line track has suspended joints, with joint ties 7 ins. apart between faces, and the rails spliced by 23-in. Samson angle bars, with four bolts spaced 4½, 7 and 4½ ins. c. to c. The width at subgrade is 16 ft. The tracklaying and surfacing were done by the railway company.

The entire construction train is shown in Fig. 1, while cars Nos. 1 to 8, both inclusive, formed the boarding or work train, which was always kept at the head of the track. The material train, composed of cars Nos. 9 and 32, both inclusive, was brought up during the night from the last side track, and stopped so that the interval between cars Nos. 8 and 9 was about 400 ft. The tie cars, Nos. 18 to 32, were then cut off at the coupling between Nos. 17 and 18, and the rail and telegraph cars were moved up and coupled to the boarding train, making the train as shown in Fig. 2.

Work commenced at 7 a. m., the teams then beginning to haul ties from the five rear cars onto the grade (which had a top width of 16 ft.), where the tie men helped to unload, place and space them. The tie wagons are shown in Fig. 3, and the chutes for loading them with ties from the box cars are shown in Figs. 4 and 5. One hundred rails and the necessary fastenings were unloaded from both sides of cars Nos. 15 and 16, dropping onto the soft earth of the roadbed, and the train then moved back 400 ft. The forks used in handling the rails are shown in Fig. 6. The 100 rails were then loaded on two iron cars, Fig. 7, each carrying 50 rails, and being "trimmed" with splice bars, bolts and spikes. The iron cars were then hauled to the end of the track by horses. Ten men on each side of the leading iron car ran forward with a rail and dropped it in place, together with a pair of splice bars and six bolts for each joint. Immediately the rails were dropped, one man threw a hook gage, Fig. 8, over them, near their outer ends, and the horse then pulled the car forward 30 ft., one man on each side stopping and blocking the car wheels with an iron chock, Fig. 9. Two more rails were then quickly run out and dropped, as before. At every fifth and sixth rail length, alternately, a 200-lb. keg of spikes was thrown off, containing about 375 spikes 9-16 × 5½ ins. These kegs were broken open by the two spike peddlers, who took 100 lbs. of spikes in their car boxes, Fig. 10, and placed two spikes on each tie where it was crossed by a rail.

The two "front strappers" put on the splices, adjusted the expansion spacing by metal shims, and fastened the two center bolts, the other strappers following and completing the joints. Four "front spikers" with a gage followed close on the front strappers, and spiked the track at joints, centers and quarters, while 12 other spikers finished the spiking. For each two spikers there was an assistant, called a "nipper," who held the tie up to the rail with a nipping bar, using a block as a fulcrum. When the rails on both iron cars were nearly all in place, the train was again run forward, and 100 rails and the necessary fastenings thrown off as before, and the train again run quickly back out of the way. The iron-car gang would "drop" 100 rails (1,500 ft. of track) in from 25 to 30 minutes. Tie cars were brought forward at about every second move of the train, or oftener if the nature of the ground required it.

At about 11:30 a. m. the ties remaining in the box cars were thrown out on the ground, to be picked up and loaded on the wagons, while the empty cars, Nos. 9 to 32, both inclusive, were run rapidly back to the nearest side track and exchanged for loaded cars arranged as before, these being brought to the front in time for work at 1 p. m. An additional locomotive, pushing at the rear of car No. 32, was employed when the grades required it.

Telegraph material was thrown off car No. 17 at each forward movement of the train. The poles were of cedar, 6 ins. diameter at the small end and 25 ft. long, set 5 ft. in the ground, and these were spaced 30 to the mile. The wire was stretched from a reel placed on a small hand wagon, pushed by men. Tents were carried on the boarding train to be set up at night for quarters for extra men, or to shelter the horses in cold weather. Detachable feed boxes were slung on the sides of the boarding cars. The general foreman had control of all trains and employees working at the front, and in cases of emergency could at any time communicate by telegraph with the Superintendent of Construction, a few miles at the rear. Material tracks from 2,000 to 2,500 ft. long were laid at intervals of about 10 miles, unless regular stations were to be provided at shorter distances.

Surfacing gangs, who lived in boarding cars set off on temporary side tracks, followed the tracklayers, and surfaced the track from the shoulders of banks or sides of cuts, so as to make a safe roadway and prevent bending of the rails or splices before the ballasting was done. These gangs usually numbered 40 to 45 men under a foreman and sub-foreman. About 250 men were required, and they went to and from work on hand cars. The boarding and kitchen cars are shown in Figs. 11 and 12.

Mr. Rich states that the company has laid much track with several of the other tracklaying devices in use in this country, and some details of tracklaying by machinery were given in our issue of Jan. 3, 1895. In swampy, very hilly, or timbered regions they were very serviceable, but in a dry, open country like North Dakota the method above described enabled the work to be advanced at double the speed and at no greater cost per mile. The average advance was three miles per day, and on one or two occasions in 1893 over four miles of track were laid in 10 hours with the force named below, and by increasing the force without regard to strict economy, five or six miles might be laid in a day.

The entire work was in charge of a Superintendent of Construction, stationed at the siding nearest to "the front," or the head of the track, who ordered and forwarded material and gave general instructions. He had a business car, a clerk, who was also a telegraph operator, and a cook. The telegraph line was in working order at the end of the track every night, the instrument and op-

erator being located in car No. 1. The tracklaying force was as follows:

Tracklaying Force; M., St. P. & S. S. M. Ry.

	Foremen.	Laborers.
General foreman on horseback	1	
Iron car gang, who dropped rails and fastenings	1	22
Strappers, who adjust and bolt splices	.	6
Spike peddlers, who distribute spikes	.	2
Tie-spacing gang	1	12
Men lining ties (with rope and stakes)	.	2
Men spacing joint ties (with 30-ft. pole and tie pick)	.	2
" leveling grade cut by tie wagon	.	4
Spikers	.	16
Nippers, who hold up ends of ties for spikers with blocks and nipping bars	.	8
Tracklining gang	1	6
Teamsters for tie wagons	1	40
Men unloading ties from cars (three to each car)	.	15
" " rails and fastenings from cars	.	4
Telegraph gang	1	8
Telegraph operator	.	1
Drivers of iron-car horses	.	2
Blacksmith	.	1
Night watchman	.	1
Cooks	.	2
Baker, who worked only at night	.	1
Waiters and helpers	.	5
Storekeeper	.	1
Total	6	161

All baking of bread and pastry was done during the night by an extra force of cooks. The cooks, baker, waiters, helpers and storekeeper were employed by a contractor, who boarded the men for $3.50 per week, furnishing all supplies and bedding. The amount for board was deducted from the wages of the men and paid to this contractor. The wages paid in 1893 were as follows:

General foremen	$150.00 per month.
Foremen of gangs	$60 to 65.00 " "
Telegraph operator	50.00 " "
Teamsters (board furnished)	35.00 " "
Iron-car gang	$2 to 2.25 per day.
Strappers and spikers	2.00 " "
Liners and unloaders of ties and rails	1.75 " "
Tie spacers, shovelers, nippers and spike peddlers	1.50 " "
Blacksmith	2.25 " "

Returning to the details of the train and equipment, the make-up of the entire train is shown by Fig. 1. The equipment and capacity of the boarding train, kept at the head of the track, shown in Fig. 2, was as follows:

No. 1. Pioneer car, double deck. This contained a blacksmith shop, 10 × 12 ft.; storeroom, 8 × 12 ft., for heavy tools, harness, etc.; office for general foreman, 12 × 14 ft., with three sleeping berths and telegraph office; two sleeping apartments on the upper floor, and a tool box under the car. In front of the car was a platform supported by rods from the top, carrying extra splice bars, bolts and spikes, and under the platform was fastened an extra iron car for emergencies, as shown.

No. 2. Store car, double deck. This had a storeroom for clothing, shoes, tobacco, etc., and another for provisions; sleeping berths for the cooks, a sleeping apartment above and a tool box underneath.

No. 3. Dining and sleeping car, double deck. On the lower floor were two dining rooms, one for the foremen and guests, the other for teamsters and telegraph gang. Above were separate sleeping apartments for the teamsters and the telegraph gang and underneath was a tool box (Fig. 11).

No. 4. Dining and sleeping car, double deck. On the lower floor was the laborers' dining room, and above was a sleeping apartment, with berths for 32 men. Underneath was a tool box.

No. 5. Kitchen car. This had a kitchen and provision room, 12 × 32 ft., with two cooking ranges. Underneath was a water reservoir supplied by hose from the water car (No. 8), while pumps in the sinks delivered the water as needed by the cooks.

No. 6. Dining and sleeping car, double deck. On the lower floor was a laborers' dining room, and on the upper floor was a sleeping apartment with berths for 32 men. Underneath was a box for wood for fuel.

No. 7. Feed car. An ordinary box car, 8 × 34 ft., carrying feed for the horses and coal and wood for the use of the cooks.

No. 8. Water car. A flat car, having at each end a wooden tank of 2,000 gallons capacity, the tanks being connected by a pipe.

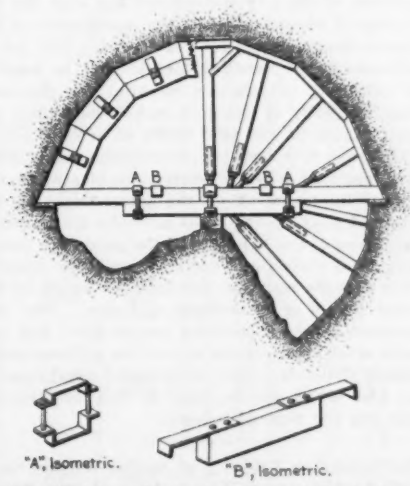
No. 9. An ordinary flat car, loaded with rails, bolts and spikes.

No. 10. (Car No. 17). An ordinary flat car, loaded with telegraph material.

The tie-wagon, Fig. 3, was a four-wheeled wagon with two V-shaped supports to hold the ties, the capacity being about 25 ties. The tie chute, Fig. 4, was a plank platform with three rollers; the inner end was attached to a transverse bar of 2-in. gas pipe, placed at any desired height across the car door and secured by turning the pointed screw at one end; the outer end was supported by an iron sling and a chain from the roof of the car. Fig. 5 shows the method of attaching and using the chute. The rail fork used in handling the rails is shown in Fig. 6. The iron car, or rail car, Fig. 7, had two longitudinal sills and four transverse sills, with planks nailed across the bottom of two of the latter to form a box for splice bars and bolts; the wheels were 20 ins. diameter and 7 ins. wide on the tread, and two rollers were fitted at each end in the usual way; each car could carry 50 rails of 72 lbs. per yd. The hook gage, Fig. 8, was used to hold the free ends of each pair of rails as laid, while the iron car was run onto these rails and stopped by the chock shown in Fig. 9. The spike peddlers' car, Fig. 10, was a handy little device, running on one rail and carrying about 100 lbs. of spikes, so that the spike peddlers could distribute the spikes very rapidly. The double-deck dining and sleeping cars, Fig. 11, were 34 ft. long over the body with a 3-ft. platform at one end; the width of the body was 12 ft. out to out, and the dining room and sleeping room had each a clear headway of 6 ft. 3 ins.; the sleeping room had two rows of berths on each side. The kitchen car, Fig. 12, was of similar dimensions, but had only one floor. In both of these cars the bodies could be removed by unbolting the four corner bolts, X X, which secured the end floor beams to the outer sills of the car frame.

THE MATTSON METHOD OF TUNNEL CENTERING.

A method of tunnel centering designed for rapid placing and removal is shown in the accompanying illustration. The upper sill is made in two pieces and these are fastened to the lower sill by the clamps and bolts, shown by the Detail A. The



The Mattson System of Tunnel Centering.

spacing blocks between the sills, Detail B, can be put in place and removed readily, the bent iron straps extending over the sills at either end, as shown at B in the tunnel section. Extensible radial braces are used, the screws being at the lower end, as shown. Curved or polygonal ribs or arch bars may be used when desired, with devices at each footing for springing the rib tightly into place.

The system, with some modifications, was recently used on a short length of tunnel for a 10-ft. brick sewer in Brooklyn. It was examined by a representative of this journal, and seemed to be giving good satisfaction. The bottom of the invert was about 32 ft. below the street level. The material encountered was gravel and cobbles. The transverse sills were each 6 × 8 ins. Where the earth core had been entirely removed four 4 × 8-in. braces were used below, and the same number and size, with two 4 × 6-in. in addition, above the horizontal center timbers, or sills.

The above method of centering was designed and has been patented by Mr. Samuel Mattson, of 236 Spencer St., Brooklyn. Mr. Mattson was the contractor for the tunnel work referred to above.

TESTS OF CAST IRON CAR WHEELS.

An interesting series of tests of chilled cast iron car wheels was made Nov. 9 at the shops of the New York Car Wheel Works and Griffin Machine Works, at Buffalo, N. Y. The tests were made under foreign specifications for tests of steel wheels and the Master Car Builders' Association standard specifications for tests of cast iron wheels, and all the wheels more than fulfilled the requirements. The general results of the tests are given in tabular form, and the following notes explain the conditions more fully:

Test No. 1.—Made on a standard double-plate wheel, under the Austrian State Railway specifications, by which the wheel must be placed upright on a heavy iron and stone foundation, and must stand eight blows from a weight of 475 lbs., dropped from varying heights, commencing at 3.28 ft., and increasing by 1.64 ft. to 19.68 ft., the test continuing until the wheel falls. This wheel stood 19 blows, nine of which were from the full height, the wheel then breaking in two pieces. Slight cracks first appeared at the seventh blow, and gradually extended.

Test No. 2.—Made under the Hungarian State Railway specifications, which are similar to the above. The wheel stood 17 blows, seven of which were from the full height. Slight cracks first appeared at the eighth blow.

Test No. 3.—Made on a 30-in. spoke wheel for engine truck, Lake Shore & Michigan Southern Ry., under the Austrian State Railway specifications for test. The first fine cracks appeared at the sixth blow, and extended until, at the 12th blow, the wheel broke.

Test No. 4.—Made on a 39-in. wheel, under the German State Railway specifications for test, by which the wheel must be placed horizontally on wooden blocks and have a tapering steel wedge placed in the center. The wheel must stand six blows of a weight of 440 lbs. falling from varying heights, commencing at 4.92 ft. and increasing by 1.64 ft. to 13.12 ft. Small cracks appeared at the 12th blow, and extended until, at the 17th blow, the wheel broke.

Test No. 5.—Made on a 42-in. wheel, under the French State Railway specifications for test, by which the wheel must be placed upright on a heavy iron and stone foundation, and stand three blows of a weight of 2,200 lbs. falling 14.76 ft., the test being continued until the wheel breaks. This wheel stood six blows without breaking, when the test was discontinued on account of the difficulty of handling the weight.

Test No. 6.—Made on a double-plate passenger wheel, under the M. C. B. specifications for test, by which the wheel must be placed horizontally on a heavy iron and stone foundation, and must stand five blows of a weight of 140 lbs. falling 12 ft., the test being continued until the wheel fails. A small crack in the plate appeared at the 38th blow, and there was a gradual development of cracks through tread and plates, the wheel breaking in two at the 56th blow.

Test No. 7.—Made under the M. C. B. specifications for test. A crack in the plate appeared at the 44th blow, no further effect appearing until a crack appeared in the tread at the 190th blow, when the cracks gradually extended until, at the 263d blow, the wheel broke.

Test No. 7.—Made under the M. C. B. specifications for test. A small crack appeared in the plate at the 23d blow, no further effect appearing until the 45th blow developed a crack through the tread. The wheel broke at the 63d blow.

Tests of Cast Iron Car Wheels Made by the Griffin Foundry & Machine Co., Buffalo, N. Y.

	Specifications for test.	Wheel. Diam., ins.	Wheel. Weight, lbs.	Drop weight, lbs.	Height of drop. ft.	No. of blow producing first crack.	No. of blows before breaking.	Remarks.
1	Austrian State Rys.	38	800	475	3.28 to 19.68	7	19	Broke in 2 pieces.
2	Hungar. State Rys.	38½	840	475	3.28 to 19.68	9	17	"
3	Austrian State Rys.	30 (spoke)	950	475	3.28 to 19.68	7	12	.....
4	German State Rys.	39	840	440	4.92 to 13.12	12	17	.....
5	French State Rys.	42	1,075	2,200	14.76	..	6	Not broken.
6	M. C. B.	36	750	140	12	38	56	Broke in two.
7	"	42	1,075	140	12	44	263	.....
8	"	33	600	140	12	23	63	.....

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A Deep-Waterway Commission has been appointed by the President, in accordance with an Act of the last Congress ordering such a commission to "make inquiry" into the feasibility of constructing a deep waterway admitting ocean vessels to the Great Lakes, to report upon the most convenient location for such a route and upon its probable cost. This commission is to confer with any similar body appointed by the authorities of Canada or Great Britain, and if any part of such waterway be located outside of the United States, the report is to include information upon necessary treaty arrangements which would make the canal free to both countries. The sum of $10,000 is allowed for the expenses of the Commission. Under the authority granted by this Act, President Cleveland has appointed as members of this Commission President Angell, of the University of Michigan; Mr. Lyman E. Cooley, C. E., long identified with the work of the Chicago Drainage Trustees, and Mr. John E. Russell, of Massachusetts, a strong advocate of a deep-water channel to the Lakes.

This is an able commission, and any report from it should intelligently present the broad question involved, and gather together and properly collate any existing information upon this subject. But this is about all it can do with the money available. To ascertain the most feasible route and to estimate cost, with any degree of certainty, will demand the outlay of many times the sum appropriated in the work of engineers. The Commission can, however, do some very valuable work in presenting to the government and to the people of the United States statistics and exhibits, more clearly pointing out the conditions under which a deep-water channel to the Lakes, by any American route, would have to be operated; the possibilities of adapting vessels to both ocean and lake traffic, the probable competition of existing ocean traders, and finally the relative economy in transport between a very costly deep-water channel, available for part of the year to a composite type of vessel not yet built, and the further improvement of existing canals—as canals for barge traffic. There is much scattered information upon these heads, coming, some of it, from sources that are not altogether unprejudiced; and to sift this out, and to fairly present both sides of the question, so that all may understand, would be the best beginning possible in an enterprise of similar dimensions. If by such a presentation the Commission can convince the people of this country that a ship canal to the Lakes can be profitably operated, as compared with other schemes of transportation, it will be then time enough to thoroughly survey routes and to estimate upon probable cost. As yet, the very great majority of the people of the United States do not know enough about the controlling conditions to intelligently say whether they want a ship canal or not. This Commission can and should enlighten them upon some of these preliminaries; and it would best perform its duties by honestly debating the question of the feasibility and commercial value of any ship canal from the ocean to the Great Lakes.

The systematic and intelligent improvement of the water-front of New York is a matter of paramount importance in the development of the material interests of commerce and shipping at this port, and has been too long delayed. Plans have been formulated and appropriations made; but under previous political complications there was little real progress, and probably less public confidence in the sufficiency of these plans. The present Dock Board, therefore, has taken a wise step in recognizing the fact that the proper solution of the serious problems presented demands the highest engineering skill and ability; and to meet this demand, the Board had created a board of consulting engineers and has appointed to this board engineers of undoubted experience and of national reputation. These men are Gen. Thomas L. Casey, late Chief of Engineers, U. S. A.; Mr. George S. Morison, President of the American Society of Civil Engineers, and Mr. William H. Burr, M. Am. Soc. C. E., Professor of Civil Engineering in Columbia College and an expert in structural engineering. This is a board of very exceptional excellence, but it is none too good for the work that it has before it. In view of the constantly increasing tonnage of steamships and the necessity for rapidly handling and storing cargoes, the insufficiency of the docks of New York has long been notorious, and the value and earning power of the city water-front has been far below what it should be when the possibilities of intelligent improvement are considered. The latest improvements in handling freight and in loading and unloading vessels are essential for the continued prosperity of this port, and without them we cannot expect to win new trade, or even to retain all that we now have in competition with other better equipped ports of entry. Incidental to the proposed improvement of the water-front on the North and East Rivers, is the necessity for a greater convenience in the handling of the passenger traffic across these rivers, and we trust that the solution of this problem may also fall into the hands of the present board of consulting engineers. The improvement of dock facilities comes first; but the greater safety and convenience of the millions crossing these rivers each year is almost of equal importance, and much can be done in this direction in laying out the general scheme.

The increasing difficulty of finding outside communities which are willing to be made the dumping grounds for city and town garbage is forcing upon a great many cities the serious consideration of improved means of garbage disposal. A good illustration of this is the case of Hoboken, N. J. The "Observer" of that city states that it has received many inquiries as to whether the contractor to whom the contract for removing garbage had recently been awarded had yet filed his bonds. It then states the reason why the bonds have not been filed. Pending the drawing of the necessary papers the contractor was allowed to remove garbage before filing his bonds. When the documents were ready for execution the contractor had twice been arrested and fined for violating the ordinances of the neighboring townships of Union and North Bergen, prohibiting the dumping of garbage within their limits. Other near-by dumping places could not be secured. Naturally enough, the bondsmen upon whom the contractor had been counting became alarmed, and, thanking their stars that the above events occurred before they had committed themselves, refused to sign the bonds. The fact that garbage can be seen, and smelled, is doubtless accountable for the fact that during the past season its disposition has caused far more objections than the pollution of streams and lakes by sewage, with more dangerous consequences. Ten years have seen wonderful advances in the popular demand for changes in garbage-disposal methods. Already the garbage of at least 50 American cities is being either burned or treated by some of the utilization processes and in a few years more, the number will doubtless have reached hundreds. Meanwhile there is much work for engineers to do in perfecting methods and educating the public on this important subject.

An error has been called to our attention in our report of the New Orleans convention of the Association of Railway Superintendents of Bridges and Buildings (Eng. News, Oct. 24), which arose in connection with the committee report on "Methods and Special Appliances for Building Temporary Trestles over Washouts and Burnouts." The error consisted in stating that the report was practically a reprint of the paper on the same subject read before the New York Railroad Club by Mr. W. L. Derr, and arose from the fact that portions of the report were taken from that paper, and that the reporter was obliged to depend upon his recollection from a cursory reading of the report temporarily loaned by the Secretary. We tender our apologies to the Association and to Mr. R. M. Peck, Chairman of the Committee, for the misstatement.

RECENT PROGRESS IN PYROMETRY.

Pyrometry, or the art of measuring high temperatures, has recently been receiving a great deal of attention from engineers and others engaged in the industrial arts. This is partly on account of an increased knowledge of the fact that observations of temperature are essential to economy of fuel, and, what is often more important, to the securing of a first-class product in many industrial processes, and partly on account of the recent invention of several different forms of heat-measuring instruments which are great improvements over any previously in use.

The saving of fuel which may be made by accurately observing temperatures and acting on the knowledge gained by such observation, is well appreciated by those educated engineers whose practice includes the use of fuel in steam boiler and other furnaces; but there is a surprising amount of ignorance on the subject among the owners of these furnaces and among the skilled workmen engaged in their operation. Many engineers, for instance, are aware of the fact that the economy attained by a steam boiler depends upon the temperatures of the gases of combustion at two points, viz., the bridge wall, or point of highest temperature of the furnace and the entrance to the chimney flue, or point at which the gases leave the heating surface of the boiler. The higher the temperature at the bridge-wall, and the lower the temperature at the flue, the greater the economy of the boiler, and a measure of the economy, stated as a percentage of efficiency, is the difference of these two temperatures divided by the greater. These facts are well known, but how rarely is a pyrometer used to obtain even one of these temperatures—that of the flue—and who (outside of a few boiler-testing experts) has ever seen a pyrometer used to obtain the temperature at the bridge wall? The extent of the waste of fuel consequent upon the neglect to observe the temperatures and to modify the boilers and furnaces after learning the lessons taught by the observations is something enormous. Some years ago a steam engineer in Pittsburg estimated that the waste of fuel in the steam boilers of that city and Allegheny alone amounted to over a million dollars per annum. It was quite common to find the temperature of the gases escaping into the chimneys as high as 800° or 1,000° F., and a similar state of affairs was general in the whole country west and south of Pittsburg—in fact, wherever bituminous coal was used as fuel.

In many other industrial operations besides steam-making in which fuel is used and in which temper-

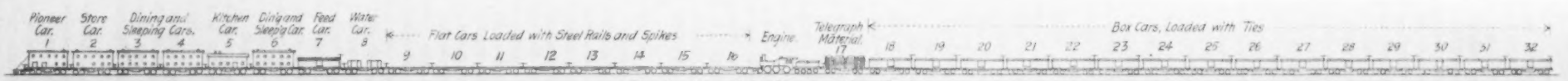

Pioneer Car. 1
Store Car. 2
Dining and Sleeping Cars. 3 4
Kitchen Car. 5
Dining and Sleeping Car. 6
Feed Car. 7
Water Car. 8
Flat Cars Loaded with Steel Rails and Spikes 9 10 11 12 13 14 15 16
Engine.
Telegraph Material. 17
Box Cars, Loaded with Ties 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32

Fig. 1. Complete Construction Train.

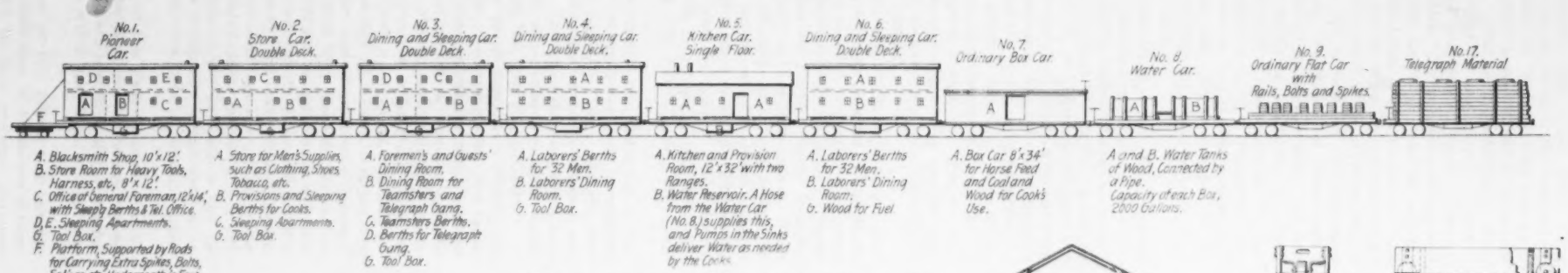
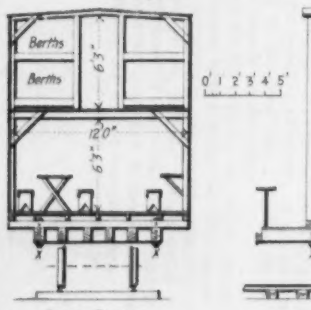
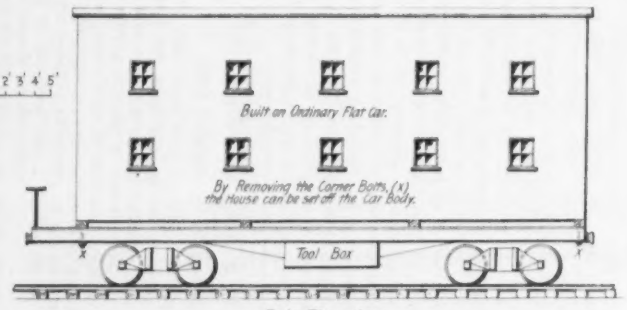

No. 1. Pioneer Car.
A. Blacksmith Shop, 10'x12'.
B. Store Room for Heavy Tools, Harness, etc., 8'x12'.
C. Office of General Foreman, 12'x14', with Sleeping Berths & Tel. Office.
D, E. Sleeping Apartments.
G. Tool Box.
F. Platform, Supported by Rods for Carrying Extra Spikes, Bolts, Splices, etc. Underneath is Fastened an extra Iron Car for Emergencies.
No. 2. Store Car. Double Deck.
A. Store for Men's Supplies, such as Clothing, Shoes, Tobacco, etc.
B. Provisions and Sleeping Berths for Cooks.
C. Sleeping Apartments.
G. Tool Box.
No. 3. Dining and Sleeping Car. Double Deck.
A. Foremen's and Guests' Dining Room.
B. Dining Room for Teamsters and Telegraph Gang.
C. Teamsters Berths.
D. Berths for Telegraph Gang.
G. Tool Box.
No. 4. Dining and Sleeping Car. Double Deck.
A. Laborers' Berths for 32 Men.
B. Laborers' Dining Room.
G. Tool Box.
No. 5. Kitchen Car. Single Floor.
A. Kitchen and Provision Room, 12'x32' with two Ranges.
B. Water Reservoir. A Hose from the Water Car (No. 8.) supplies this, and Pumps in the Sinks deliver Water as needed by the Cooks.
No. 6. Dining and Sleeping Car. Double Deck.
A. Laborers' Berths for 32 Men.
B. Laborers' Dining Room.
G. Wood for Fuel
No. 7. Ordinary Box Car.
A. Box Car 8'x34' for Horse Feed and Coal and Wood for Cook's Use.
No. 8. Water Car.
A and B. Water Tanks of Wood, Connected by a Pipe. Capacity of each Box, 2000 Gallons.
No. 9. Ordinary Flat Car with Rails, Bolts and Spikes.
No. 17. Telegraph Material

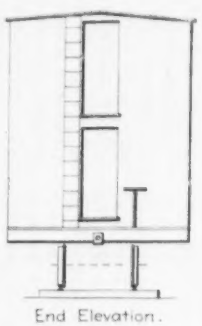
Fig. 2. Boarding or Work Train at Head of Track.



Cross Section.



Side Elevation.



End Elevation.

Fig. 11. Dining and Sleeping Car.

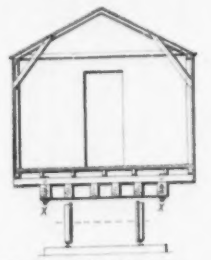


Fig. 12. Kitchen Car.

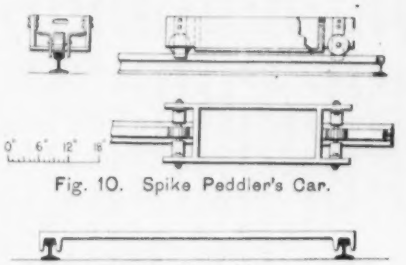
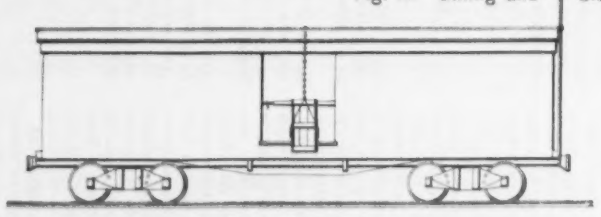
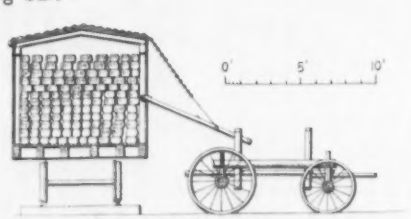


Fig. 10. Spike Peddler's Car.

Fig. 8. Hook Gage.



Side Elevation



Cross Section.

Fig. 5 Method of Loading Ties.

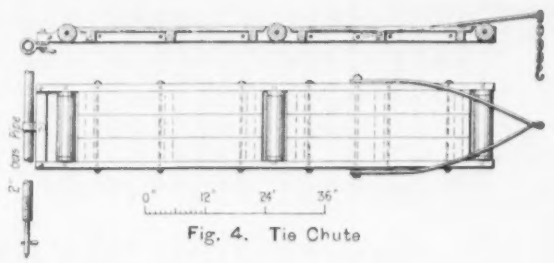
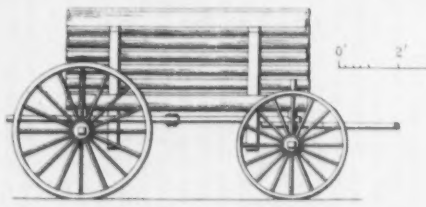


Fig. 4. Tie Chute



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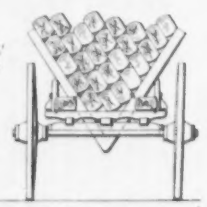


End Elevation.

Fig. 3. Tie Wagon.

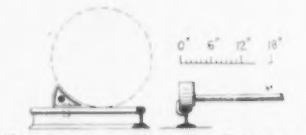


Fig. 9 Stop Block for Rail Car.

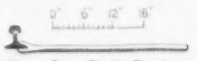
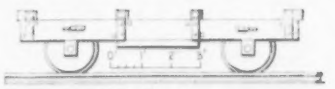
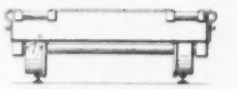


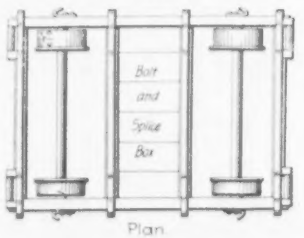
Fig. 6. Rail Fork.



Side Elevation.



End Elevation.



Plan

Fig. 7. Iron or Rail Car.

Tracklaying Train and Appliances; Minneapolis, St. Paul & Sault Ste. Marie Railway.

W. W. Rich, M. Am. Soc. C. E. Chief Engineer.

atures are guessed at, the use of pyrometers may prove of great service. In the casting of metals failures are frequently due to the metal being poured while too hot or too cold, the temperature being judged by the eye. Steel is often injured in the furnace by being overheated, and in rolling by being withdrawn from the furnace before it is heated enough. Could the temperature of the furnace be checked by a pyrometer, much of this injury might be avoided. The tempering of tool-steel is done by its being heated to what is called a cherry red, a temperature judged by the eye, and after cooling in water or in oil, by being drawn by reheating to another temperature, which is judged by the color of a film of oxide on the brightened surface of the steel. Could both of these temperatures be indicated by pyrometers, much loss and imperfections in tempering might be prevented. In like manner the melting and tempering of glass, the baking of pottery and other industrial operations in which fuel is used might be conducted more perfectly and with greater economy of fuel than they are at present if pyrometers were regularly employed in them.

A remarkable illustration of the great variation in the strength of hardened tool-steel due to variable temperatures used in hardening is given by Mr. A. A. Simonds, of Dayton, O., in the "American Machinist" of Sept. 19. Six pieces of the same bar of steel, 1 in. wide and ¼ in. thick, were hardened at different temperatures, the difference between that of each bar and the next in order being 40° F., and then, without drawing the temper, were broken by transverse strain in a testing machine, the distance between supports being 6 ins. The breaking loads of the six pieces, the first being the one hardened at the lowest temperature, were 1,550, 1,010, 825, 665, 420 and 350 lbs.

To test the variations which occur in the tempering of steel in ordinary practice, a list of 14 manufacturers was selected, and to each of them were sent five pieces of tool-steel to be carefully hardened. All these test pieces were cut from the same lot of steel carrying 1 per cent. carbon. When the pieces were returned they were broken by transverse test as before, and the results obtained from each set of five were averaged. The results from the 14 lots were as follows: (The figures give breaking loads in pounds.) 265, 288, 383, 487, 490, 536, 549, 728, 740, 925, 971, 987, 1,223, 1,231.

It will be seen from this that there was a very great variation in the hardening done in different establishments. It was also shown, however, that the hardening done in the same establishment was far from uniform. Thus the five pieces which gave the average 265 lbs. above showed separate breaking loads as follows: 100, 180, 235, 253, 500.

The reason why pyrometers have hitherto not been generally used in manufacturing and industrial operations is that pyrometers which combine the requirements of ability to measure correctly high temperatures without deterioration of the instrument and convenience of operation have not been available. Within a few years, however, numerous new pyrometers have been invented and placed on the market, and are still being developed and improved, so that it is probable that before many years engineers and manufacturers will have at their command instruments which will measure with great convenience and with considerable accuracy the temperature of any oven, kiln or furnace, or bath, of liquid metal contained in a furnace or ladle. Some of the instruments now on the market give a continuous record upon a diagram in the manner now used in recording pressure gages.

On another page of this issue we have given an account of the principles used in various classes of pyrometers, and have described and illustrated the principal forms which have been invented and used.

A careful reading of this article will indicate to practical men which form of pyrometer is most likely to be suitable to their particuar purposes in the measurement of high temperatures, but the following summary may here be given of the general scope of the several forms:

1. For fairly accurate measurements, taken at infrequent intervals, of temperatures of flues, ovens, etc., which at no time exceed 800° F., the mercury thermometer, with compressed nitrogen, is probably the most available instrument.

2. For approximate indications of temperatures not exceeding 1,200° F., the ordinary copper and iron tube pyrometer is most convenient, and it has the especial advantage of being visible at a considerable distance, since its readings are obtained from the position of a pointer on a large dial. Unless it is used by a person who understands its inaccuracies, and knows how to correct them, however, its records are wholly unreliable.

3. For continuous record of temperatures up to 600° F., the Bristol recording thermometer is most suitable and fairly accurate.

4. For occasional determinations of the temperature of furnaces, flues, etc., not exceeding 1,500°, the copper-ball pyrometer is suitable, and for temperatures up to 2,500° F. the platinum-ball pyrometer.

5. For rough occasional determinations of various temperatures, the melting of pieces of metals and alloys may be observed. The melting points (degree Fahr.) of several of these are as follows: Lead 1, tin 2, 360°; tin 8, bismuth 1, 392°; tin, 442°; lead 1, tin 1, 466°; lead 2, tin 1, 475°; bismuth, 504°; lead, 618°; zinc, 779°; aluminum, 1,157°; copper, 1,929°.

6. For convenient estimations of the approximate temperature of furnaces above dark-red heat, Mesure & Nouel's optical pyrometer appears to be most excellent.

7. For occasional determinations of the temperatures of blast-furnace gases, Hobson's hot-blast pyrometer is very convenient and not expensive.

8. For furnaces used for heating steel for tempering, the Simonds electrical pyrometer appears to be most useful.

9. For accurate determinations of very high temperatures up to 2,500° F., or even beyond, the air thermometer, Le Chatelier's and Callendar's thermo-electric pyrometers and Uehling & Steinhart's pneumatic pyrometer are to be recommended, the first two for scientific purposes only, as they require great care in manipulation, the last for commercial as well as accurate work, since it is extremely convenient in operation.

10. For continuous record of all temperatures between 600° and 2,700° F., the Uehling & Steinhart pyrometer, with Bristol's recording attachment, appears to be most desirable.

The advantage of continuously recording the temperatures of an oven or furnace are self-evident. For such purposes as japanning, vulcanizing of rubber, baking of pottery, etc., where the temperature is required to be confined within certain limits for a definite length of time before withdrawal of the product or decrease of the heat applied, the recording thermometers and pyrometers would appear to be almost invaluable. As a safeguard against occasional negligence of workmen, they should be as valuable in furnace work as recording steam-gages are in their particular field.

LETTERS TO THE EDITOR.

THE POWER OF WINDMILLS.

Sir: Now that wind engines are coming into such general use, especially for the pumping of water, the following simple empirical formulas may, perhaps, be of convenience to some of your readers.

They apply only to first-class wooden wheels of the best American type of construction, and which are used for the pumping of water, as the only reliable data at hand at the time that I devised them were obtained from wheels of that class.

If q be the quantity of water, in American gallons, raised per minute when the wind engine is running at full capacity; Q, the average quantity raised per day; h, the height, in feet, through which it is raised; D, the diameter of the wheel in feet, and W H P, the net horse-power consumed in raising the water, with the wheel running at full capacity, then

$$W\,H\,P = .0001\,D^3 \qquad (1)$$

$$q = 0.4\,\frac{D^3}{h} \qquad (2)$$

and

$$Q = 180\,\frac{D^3}{h} \qquad (3)$$

Respectfully yours,
M. Fargusson.

Southport, N. C., Nov. 2, 1895.

(Data concerning power and capacity of windmills are not plentiful, and we would be glad if some of our readers would compare the above formulas with their practice, and let us know if they can be considered reliable. We have made a comparison of the formulas with some figures given in Mr. Wolff's book on "Windmills," resulting as follows:

Power of Windmills.

	Diameter, ft.						
	10.	12.	14.	16.	18.	20.	25.
HP., .0001 D^3 =	.0.1	.17	.27	.41	.58	.80	1.56
HP. for a wind velocity of 16 miles per hour, Wolff	.12	.21	.28	.41	.61	.78	1.34
Quantity, gallons per min., 100-ft. lift, by formula $q = 0.4\,D^3 \div h$	.4.	6.8	10.8	16.4	23.2	32.	62.4
Do. vel. 16 miles per hr., Wolff	.4.75	8.5	11.2	16.2	24.4	31.2	49.7

We may make one criticism upon Mr. Fargusson's formulas—viz., that they contain no expression for velocity of the wind. The "full capacity" of a mill is a variable quantity, depending upon the velocity of the wind. Whether the power of a mill varies as the square of the velocity or as the cube (which latter appears to be theoretically correct) or as some other power, is not agreed upon by writers on the windmill. Can any of our readers furnish us results of experiments on this point? Ed.)

INDUSTRIAL CONDITIONS AT BIRMINGHAM, ALA.

Sir: I have glanced at your paper dated Oct. 24, and notice the editorial correspondence from Birmingham, Ala., on which I make the following comments:

You say the eight blowing engines at Ensley are all in use to blow the three furnaces, and additional engines have been ordered, to increase the blowing capacity up to the requirements of the four furnaces. The fact is that there are 12 blowing engines of the same type and size, which were all built at the same time and stand in one room, and if your correspondent had counted them, he could not have failed to make the number 12, instead of 8. There is no new engine ordered or contemplated, as the blowing capacity is now, and always has been, fully equal to the requirements of the furnaces, having been originally laid down there 50% greater than the normal furnace practice demanded.

You say that at the Bessemer Pipe Works may be seen two novelties, which will probably soon be generally adopted in Southern coke works—namely, the washing of coal before coking and the utilization of the coke-oven gas. The fact is that this company does not coke one pound of coal that has not previously been washed, although it is using 5,000 tons per day at its different works in Alabama and Tennessee for that purpose. We have been washing coal continuously since 1879 down to the present date at one or more of our plants. We have been using, for the purpose of raising steam, drying firebricks, or other purposes, coke-oven gas since 1877. So that there is no shadow of novelty on either the one point or the other.

You say that the appearance of the city of Birmingham is worse than in 1891, when rows of stores had the sign "To Rent" in their windows, and that the town as a whole looks as if it had not enough money to keep itself clean, and that the price of land is likely to go much lower, unless some new industries are brought into the city. All of these statements are incorrect and misleading. There are not 15 desirable store houses vacant in the city. The demand for them is such that rents were advanced on Oct. 1, which is the annual contracting day, on an average of 25% over those prevailing last year. The price of land has advanced since last April fully 10% on an average, and in some places 25%. Your correspondent may have struck the city on a dusty day, but the water supply is larger and cheaper, and the water purer, than that of any other city within 200 miles radius. There may not be as much money here as your correspondent would desire, for we spend our money very freely down here in new works and promoting prosperity. But there is so much improvement and repair work going on that it is impossible to get mechanics enough to fill the demand, either amongst carpenters, painters, or house furnishers and decorators. The hotels are full every night, and turning people away, and the Caldwell House is greatly missed and needed. It is wholly incorrect that the ruins remain untouched since the fire, as stated by your correspondent, as a force has been at work removing them from at least a portion of the site, and constructing there for the past four months a new sanitarium, or medical institute.

As to the necessity of new industries, I will confine myself to saying that the price of lumber has advanced; that the wood-working establishments in the city are 30 days behind their orders; that a new cotton mill is now having the machinery erected; that two cotton compresses are running here, as against one last winter;

that we expect to handle 75,000 bales this winter, as compared with 25,000 last year; that a knitted hosiery mill has been started during the summer; that there is not one engine and boiler works in the place (as suggested by your correspondent to be required), but seven or eight, which are working overtime, and fully equipped; that the street railroads' receipts are 50% greater than they were last year; that the only bank which suspended during the panic has since resumed, and is enjoying its old-time confidence and prosperity; that not one single wholesale merchant in the city failed during the panic; and that the production of both iron and coal is larger than it has ever been in this district since its commencement, notwithstanding the few idle furnaces on which you comment.

Yours truly, James Bowron.
Treasurer, Tennessee Coal, Iron & Railroad Co.
Birmingham, Ala., Nov. 2, 1895.

(We tender our apologies to Mr. Bowron for our unfortunate error in stating that the Ensley furnace plant contained eight blowing engines instead of twelve, the correct number. The member of our staff who visited Birmingham received information from an officer of the company to the effect that all the engines of the plant were now blowing three furnaces, that the three furnaces were taking all the air that the four formerly did, and that the three furnaces made more iron than four did formerly. The statement as to new engines being ordered he believes came from an engine-builder. With regard to the novelty of the utilization of the coke-oven gases for heating air for drying cores and for raising steam, and of the improved coke-washer, coal-washing in the South is, of course, not new, but the new washing plants at Bessemer and the Pratt mines, with the important improvements introduced by Mr. Erskine Ramsay, are certainly not old enough yet to be improperly called novel. In a paper by Mr. J. J. Ormsby, of Tracy City, Tenn., read at the February meeting of the Institute of Mining Engineers, he says: "Attempts at coal-washing have been made in the Southern states during the last 20 years, but it is only within the last four or five years that the practice has become at all general."

The chief criticism Mr. Bowron has to make, however, upon the article referred to, concerns our representative's impressions of the city of Birmingham.

While our representative's information as to that city was gained during two hasty visits of a day each, coupled with his experience in a 10 weeks' residence in the city in 1891, his statements are not so wholly irreconcilable with those of Mr. Bowron as might appear at first sight. Mr. Bowron says, for example, that there are not 15 desirable store houses vacant in the city. He does not say that there are not many more storehouses vacant which are undesirable by reason of their being located two or three blocks away from the business district; and it was these vacant stores to which we referred. With respect to the statement that the price of land has advanced since April, our comparison was plainly between the present prices and those of four years ago. We can easily believe that the improvement in the iron market of the past six months has been reflected in real estate prices.

As to the Caldwell House ruins, our representative's inspection gave him the impression that the ruins of the hotel itself were untouched since its destruction, as he stated, and that the new sanitarium to which Mr. Bowron refers is being erected on the site of some of the adjacent buildings which were burned at the same time as the hotel. If this is a mistake, we cheerfully accept the correction.

As to the new industries in Birmingham, we are glad to learn that they are so numerous, and especially that there are seven or eight engine and boiler works working overtime and fully equipped; but our remarks as to new industries being needed are still, it appears to us, correct. We said:

> The time would seem ripe for the building of a first-class general foundry and machine shop, which would make engines, machinery and castings for Southern use.

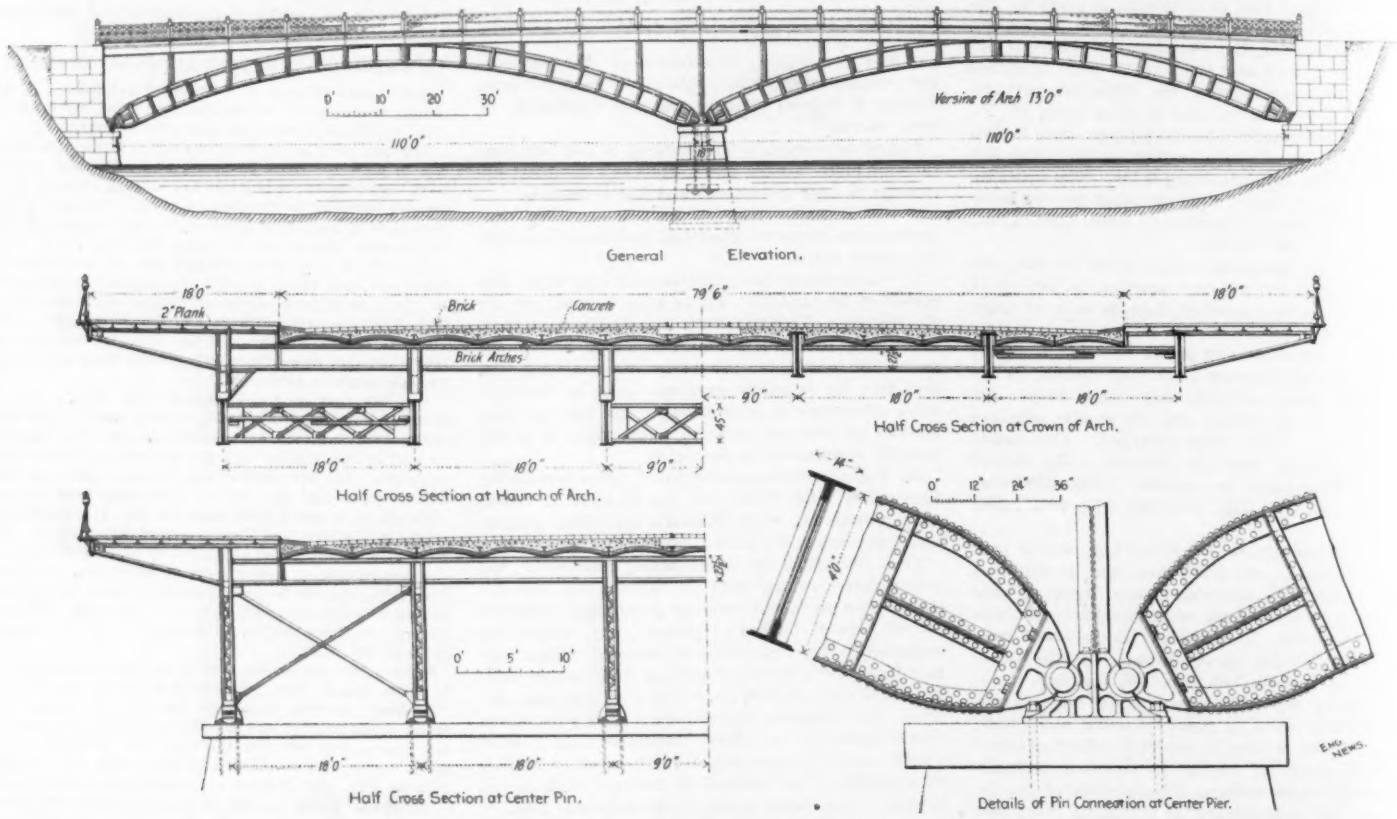
What we had in mind was an establishment like the Southwark, of Philadelphia; the Fort Pitt, of Pittsburg, or the E. P. Allis Co.'s works in Milwaukee. Mr. Bowron will surely not dispute this statement, notwithstanding the seven or eight engine and boiler works already in Birmingham.—Ed.)

STEEL ARCH HIGHWAY BRIDGE, LANSING, MICH.

We illustrate herewith a steel arch bridge, recently constructed to carry Michigan Ave. over the Grand River, at Lansing, Mich. This structure is deserving of particular interest, on account of its extreme width, 115½ ft. over all, and the unusually substantial character of its floor system. As will be seen from the illustrations, the bridge consists of two 110-ft. arched girder spans carried on masonry abutments and center pier (Fig. 1). Each span consists of six parallel girders spaced 18 ft. apart c. to c. These girders average about 4 ft. in depth, with a rise of 13 ft., and the alternate pairs are braced together with transverse latticed struts and angle diagonals. The floor beams are 11 ft. apart c. to c., and are carried on vertical struts supported on the girders, as shown in Fig. 2. On top of the floor beams, which are 27½ ins. deep, are placed a series of longitudinal I-beams 6 ft. apart c. to c., between which are sprung single-ring brick arches. These arches are covered with a layer of concrete, on which is laid the brick paving.

The abutments and piers are built of Ohio sandstone masonry laid in Portland cement mortar. The foundation bed is a hard, blue clay, and upon this was placed a concrete footing for the masonry. Both masonry and concrete are first-class in all respects. The contract price of the completed structure was $60,000.

The work was let in three contracts: The substructure to Messrs. Newland & Frazer, of Lansing; the ironwork erected to the Wrought Iron Bridge Co., of Canton, O., and the roadway, pavement and sidewalks to Mr. M. E. Fitzpatrick, of Lansing. The bridge, with a few alterations in the substructure, was built upon plans furnished by Mr. E. J. Landor, M. Am. Soc. C. E., Chief Engineer of the Wrought Iron Bridge Co. Mr. H. D. Bartholomew is City Engineer, and Mr. E. O. Sellers is Superintendent of Public Works. We are indebted to Mr. Sellers for the information from which our illustrations and this description have been prepared.



STEEL ARCH HIGHWAY BRIDGE, LANSING, MICH.

E. O. Sellers, Superintendent of Public Works, Lansing, Mich. Wrought Iron Bridge Co., Canton, O., Designers and Contractors.

NOTES OF TRAVEL; CHICAGO TO NEW ORLEANS VIA ST. LOUIS.

(Editorial Correspondence.)

Illinois Central R. R.

However familiar one may think he is with the "magnificent distances" covered by our American railway systems, he will occasionally bump up against figures which startle him. It was this way when the writer, in securing his ticket from Chicago to New Orleans, discovered that he was nearly as far by rail from the Gulf of Mexico as he was from New York Harbor, despite the round-about routes of the Eastern trunk lines. To put it exactly, the distance from New York to New Orleans by the Illinois Central R. R.—by the way, the most direct route between the two cities, as well as the only railway which runs over its own tracks the entire distance—is 913 miles, while to New York by the Pennsylvania, New York, Lake Erie & Western and the Lake Shore & Michigan Southern-New York Central routes, respectively, the distances are 912 miles, 986 miles and 982 miles. These railway distances are the standards of measure for the traveler. If one measures as the crow flies, or, to use a distinctly American expression, "in a bee-line," New Orleans and Boston are about equally distant from Chicago. This is doubtless very elementary geography, but there may be others who, like the writer, did not know it.

From the new station of the Illinois Central R. R. in Chicago a good idea is had of the extent of the Lake Front Park improvement which this company will carry out in conjunction with the city of Chicago. The proposed work was fully outlined in the Engineering News of Sept. 12, and need be briefly mentioned only. According to the plans, some 164 acres will be reclaimed from Lake Michigan and added to the present 41 acres of park, and the work will entail the construction of 7,450 ft. of sea wall, several thousand feet of retaining wall, five roadway and seven footway bridges, and miscellaneous work to the cost of about $1,100,000 to the railway. Except the filling of the 164 acres of submerged land, practically all of the work will be done by the Illinois Central R. R.

With the Lake Front Park completed, the Illinois Central R. R. station in Chicago will have perhaps the finest outlook of any railway station in this country. In respect of stations, however, this road is well provided at each of the three great cities on its southern main line, for at St. Louis and New Orleans, as well as at Chicago, there are new and expensive structures, which are equaled by those of few railways in the country. Just outside of Chicago, at Burnside, the company is erecting extensive new machine and car shops, and these will be described in Engineering News in a separate article.

St. Louis.

In St. Louis municipal work is confined to the ordinary routine improvements, with the exception of the Water Commissioner's office, where the completion of the new water-works is keeping every one busy, but visits to some of the manufacturing plants developed various things of interest. Just now the newspapers are having much to say about a new bridge across the Mississippi River, by which it is hoped to break the shackles of the Eads bridge monopoly. The agitation seems to be based on the fact that the charter by which the owners of the Eads bridge were guaranteed protection against the construction of another bridge within a mile of it either up or down stream, will expire in about nine months, leaving the way open to the erection of a bridge anywhere the city may choose. Work on high, steel-frame buildings is furnishing business to the iron and steel men and the building trades, several 10 to 16-story buildings being now under way or planned.

The building construction which is just now most in the minds of the citizens is the new City Hall, which, if half of what is stated is true, is about as rotten a piece of work as has recently come to notice. This building has been in a sort of spasmodic process of construction for several years, and is not only far from finished now, but may have to be practically rebuilt in many particulars. The feature which attracts the readers of Engineering News most, however, is the faulty ironwork. The contract for this work was let in April, 1891, on plans and specifications furnished by the architect. As near as can be ascertained, these plans were none too good, but however this may have been, the contractor seems to have paid little attention to them in doing his work. In a recent report by Mr. Carl Gayler, M. Am. Soc. C. E., the fact is brought out that the ironwork is generally too light, that radical reductions and changes from the specified sections and details have been made, and that in many cases the material and workmanship were criminally poor.

These City Hall defects appear to preach a forcible sermon on the inadvisability of letting architects prepare plans for engineering work, and especially on the dangers of using cast iron columns. Just who is responsible for the City Hall work is not easy to get at, for the accusations and recriminations seem to be mutual, and as it is the intention of the Department of Public Improvements to have a thorough investigation made, it is probably best to forego criticism until the results of this investigation are known.

Blackmer & Post.—This firm is experiencing an improvement in business as compared with the past two years, although the volume of business even yet calls for only about two-thirds the full capacity of its plant. Throughout the recent business depression the firm has found it advantageous to cultivate special business, or, more plainly, to seek orders for special sizes and shapes of pipe in preference to pushing the standard sizes and shapes. This they have been able to do to good advantage on account of their improved machinery, with which smaller firms could not compete.

Among the special sizes of pipe which they are now manufacturing are both 27-in. and 30-in. double-strength pipe, which they strongly advocate as cheaper and more satisfactory than brick sewers of these dimensions. The opinion is quite general among engineers that a thoroughly vitrified, strong and durable pipe over 24 ins. in diameter cannot be made to compete in price with a brick sewer of the same size, but Mr. Post claims that this is not true where the cost of transporting the pipe to its destination is not over 25 cts. per lin. ft. With a cost of transportation to the trench of 25 cts. per lin. ft., it is estimated by the manufacturers that a 30-in. pipe sewer will cost about $1.65 per lin. ft., exclusive of excavation, and it can be laid much more rapidly than a brick sewer. The considerably smaller frictional resistance of the pipe, as compared with the brick sewer, makes it preferable where the cost is no greater, so that it is well worth the time of the engineer to consider the question suggested by Messrs. Blackmer & Post.

The machinery for manufacturing pipe of these large diameters is interesting chiefly on account of its size. Especial care has to be taken in handling the wet mold from the press, and on account of the weight of the sections, derricks have to be used to hoist them, after drying, into the kilns. The firm has a considerable sale for the smaller sizes of pipe for the protection of piles from the toredo navalis. The pipe is simply slipped over the pile after driving, and the annular space between the pipe and pile is filled with sand. It is stated that, owing to the sand cushion, the pipe shows a remarkable strength against breakage from floating drift. A very considerable amount of this pipe-protected piling has been used in Galveston Bay during the last year.

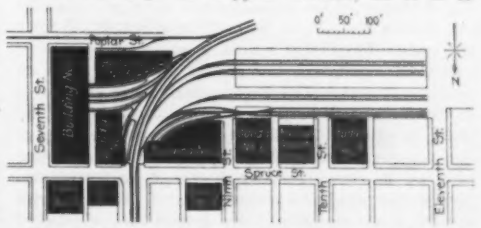
St. Louis Sanitary Co.—Having in mind the complaints of the St. Louis papers regarding the nuisance caused by the garbage-reduction plants of this company, a visit was made to the larger of the two plants now in operation. This plant and the system of garbage collection and disposal in St. Louis were fully described in the Engineering News of Nov. 1, 1894, and will not be gone into here. As far as any nuisance caused to the surrounding population by the reduction plant, the writer can only say that he could not see where it occurred. Even within the building the odor was hardly perceptible, and in the office, separated by a narrow hall and two doors from the receiving room for raw garbage, there was no odor at all. Indeed, the precautions taken to secure cleanliness in and about the building and among the workmen seem almost excessive. The laborers are required to change clothes and bathe when leaving work, all the garbage wagons are washed with hot water after each load and before leaving the building, and the concrete floors, metalwork, etc., are kept thoroughly washed.

As indicating the disposition of the people to cry "nuisance" about the disposal of garbage with little cause, it is somewhat amusing to note how the company has overcome complaints regarding the passage of their wagons through the streets. The first wagons built had painted on them the words "Garbage Cart," but after complaints began this lettering was taken off, and the people, no longer seeing this sign, soon forgot all about the "foul odor" their eyes had discovered before the change. Baseless as the ordinary complaint is, however, the experience at St. Louis teaches a lesson which should be remembered by cities proposing to adopt some method of garbage destruction or utilization, and this lesson is to locate their disposal plant in the outskirts, or better, well away from the city and the population. If anything else is done, there is almost sure to be complaint.

In the matter of treating the garbage the company has several improvements in view, which it expects will reduce cost and facilitate work considerably. At certain times of the year very large amounts of cabbage leaves and similar vegetable matter have to be treated. These materials are of almost no value for grease or fertilizer, but, owing to the large amount of water in them, they are expensive to treat. The company proposes to try pressing this material to squeeze out the bulk of the water before admitting it to the driers. It is thought that by this method a considerable reduction in the cost of treatment can be made.

Cupples Clearing House.—The possible economy of having all the wholesale business of a city confined to a single locality, with common facilities for handling, receiving and shipping goods, has attracted merchants ever since railways became the almost universal means of transportation. Probably the most successful effort along these lines in this country is the group of wholesale stores and the clearing depot of the Cupples Real Estate Co., which is shown by the accompanying sketch plan. This plant is particularly interesting to the engineer as involving the largest single installation of hydraulic elevators perhaps in the world, there being altogether 57 of these, all run from a central plant. In a future article the mechanical details of this elevator plant will be fully described, but attention will be confined here principally to the general scheme and operation of the clearing house, which is well worth a visit from any engineer who may have the opportunity.

The buildings of Cupples Station, as it is locally known, are located on both sides of the Terminal R. R. Association's tunnel tracks, which connect with all of the railways entering the city of St. Louis. The station tracks extend in many cases through the basements of the building and connect with freight platforms at the basement level. These freight or car-level platforms are in turn connected with the shipping rooms of the second floor by the elevators referred to above.



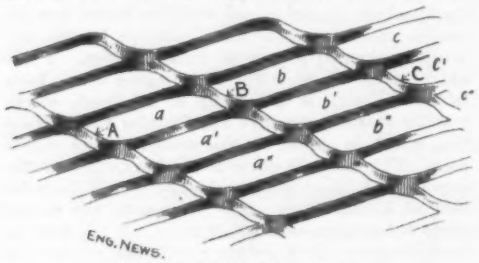
Plan of Tracks and Wholesale Stores at Cupples Station, St. Louis, Mo.

The cars are unloaded onto specially-designed trucks, and when it is stated that 3,000 of these trucks, each of 5,000 lbs. capacity, are necessary to handle the daily traffic, some idea of the amount of business is obtained. The trucks are pushed into the cars, loaded and drawn to the elevators of the various buildings, where they are raised to

the proper floor and the goods unloaded. The method of loading the cars is, of course, just the reverse of this process. The operations of a single day are about as follows: During the night cars are being delivered onto the station tracks by the various railways, and at 7 o'clock in the morning the station force begins to unload them. By 9 o'clock the unloading is practically finished, and immediately thereafter the force begins to receive goods from the various stores and load them onto the cars. It will be understood that all this trucking, loading and unloading are done by the station force under the direction of a station master, but that all handling of the goods in the stores is done by the different firms who rent these stores from the real estate company.

The foregoing brief description will give a general idea of the clearing-house scheme, but of course the conveniences for handling freight thus generally described are carried out to the minor details. The sketch plan shows the present extent of the buildings, but new stores, platforms, warehouses, etc., are being added all the time. These buildings are all fireproof, are lighted by electricity, heated by steam and every effort made to decrease fire risks. A separate building contains the boiler and power plant, and from it the heat and power are conveyed through tunnels to the various consumers. The greatest consumption of power is in handling the 57 freight elevators, and, as already stated, this plant will be described in detail in another issue. Some idea of the importance of Cupples Station in the business of St. Louis is indicated by the fact that the U. S. Postal Department has found it necessary to establish a branch station in one of the buildings to handle the mail of the different firms.

The St. Louis Iron, Wire & Expanded Metal Co.—The increasing business of this firm in its expanded metal lathing and fireproof flooring has compelled it to erect large new factories in the northern outskirts of the city. A visit to the factory found work stopped in observance of a

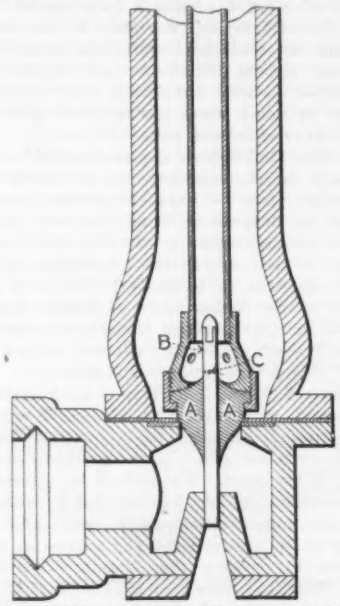


Expanded Metal Lathing.

local holiday, but through the courtesy of the company's engineer, Mr. A. L. Johnson, an opportunity was had for examining the machinery for making the expanded metal and other features of the business. The manufacture of the expanded metal consists simply in cutting a series of rows of gashes diagonally across a sheet of soft steel and then expanding the gashes so as to form an open meshwork. The accompanying cut of a piece of the metal will help to explain the process. The teeth, so to speak, of the upper or moving blade of the shear cut the gashes a b c, a' b' c', etc., one row at a time, leaving between the adjacent gashes the uninjured strips of metal, A, B, C, and in the same operation the gashes are expanded sidewise a distance equal to the passage or lap of the two shear blades by each other. The expansion is due partly to the stretching of the strips A, B, C, etc., and partly to a general contraction of the whole plate lengthwise.

Soft plate steel thoroughly annealed is used, the gage or thickness of the plate depending upon the purpose for which the expanded metal is to be used. For lathing No. 16 gage, and for flooring No. 24 gage, plate is used. Some idea of the amount of expansion may be gained by comparing the dimensions of the original plate with those of the resulting plate of expanded metal. For lathing, the original plate is 108 × 8 ins., and the expanded plate is 102 × 20 ins., while for flooring, the original plate is 108 × 7½ ins., and the expanded plate is 96 × 40 ins. It will be seen that lengthwise of the original plate there is a contraction, and crosswise an expansion, the contraction lengthwise depending upon the size of the openings a, b, c, etc. For example, the mesh of the flooring is 2½ ins., while that of the lathing is but ¼ in., and the contraction of the plates lengthwise varies correspondingly.

The use of expanded metal in constructing fire-



Valve and Waste Pipe for National Hydrant.

proof partitions, ceilings and floors is too familiar to require description. The largest recent contract for the flooring is for the Century Building in St. Louis, where 230,000 sq. ft. will be used.

Pleuger & Henger Mfg. Co.—The foundry of this company was found running at its full capacity on water-works and plumbers' supplies, and the volume of business is reported to be satisfactory. Recently the company has been pushing its "National" pressure fire hydrant, and a very considerable part of the output of the foundry is hydrant castings. This hydrant has several efficient features in the construction of the valve and waste water mechanism, which are especially noticeable for their few parts and simple form. In the accompanying view A is a vulcanized-rubber washer, which in operation slides up and down a copper waste tube, B, perforated with holes, C, near the top and wasting at the bottom of hydrant. When the valve is open the washer covers the perforations and no waste takes place, but when the valve closes, these holes are uncovered, and the water in the body of the hydrant wastes through them, as clearly indicated by the drawing. Few novel features are found in the foundry work, except that molding machines are used in considerable numbers.

Evans & Howard Sewer Pipe & Fire Brick Works.—This firm can justly claim to be one of the oldest sewer pipe manufacturers in this country, the first building having been constructed in 1855, or just in the infancy of the sewer pipe industry in the United States. The present buildings cover an area of 25 acres, and are located at Howard, a suburb of St. Louis, situated on the lines of the Missouri Pacific and the St. Louis & San Francisco railways. Besides sewer pipe, the firm manufactures building and firebrick, terra cotta plumbers' stoneware and miscellaneous specialties.

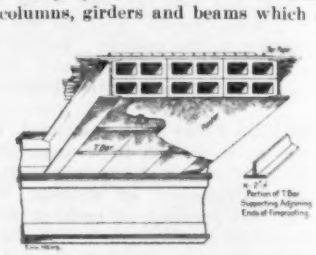
At present sewer pipe 24 ins. in diameter is the largest size made, but the firm is seriously considering the advisability of adding a 36-in. press to their plant. The usual types of Vaughn and Barber presses are used, but Superintendent R. F. Grady is working on several improvements which he considers will add considerably to their efficiency. The principal improvement is the substitution of piston valves of special design to reduce back pressure, which, with the present form of valves, is the source of considerable loss of power. The thing of most interest to the engineer, however, is the variety of uses to which the Chelten-

ham clays used are found to be adapted by suitable proportioning of the mixtures of different clays, and by different degrees of seasoning. The clay is allowed to season from one week to 30 days, according to the use to which it is to be put. The manufacturers claim that this seasoning of the clay is just as important and has just as noticeable an effect upon the quality of the manufacturing product as the seasoning of timber does in timber construction. For sewer pipe, surface clay and burnt clay are mixed in about equal proportions, and for firebrick these clays are mixed in the ratio of about 4 parts to 1 part. Something of a specialty is made of firebrick for locomotive firebox arches and zinc works, and the standard shapes and sizes of firebrick used by a large number of different railways and zinc works are carried in stock.

THE EFFECT OF FIRE ON A PARTIALLY FIREPROOFED BUILDING.

In a serious fire on Nov. 5 in New York city, the eight-story Manhattan Bank Building, which was commonly supposed to be of modern fireproof construction, was badly damaged in its upper portion. The fire originated in an old building situated on the opposite side of Bleecker St., whence it spread to the Manhattan Building, the heat breaking the windows and igniting the contents of each floor. In the seventh and eighth stories a large amount of inflammable material was stored, and the beams supporting a portion of the floors became warped by the intense heat and gave way. Below the seventh story the floors are all intact, although swept almost clean by the fire.

The failure of the upper stories led to an investigation by a representative of this journal of the so-called fireproof construction of the building, and it was found that no claim for a construction of that nature could properly be made. No building containing columns, girders and beams which are only



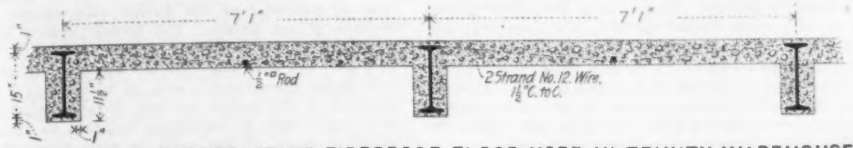
View Showing Floor Construction in Manhattan Bank Building.

partially covered by fireproofing material and consequently exposed to the direct action of the flames, can be said to be fireproof. The floors are supported by heavy transverse girders spanning the entire width of the building, 40 ft., and resting at one end on cast iron columns and at the other on piers of masonry in the street wall. These cast iron columns are only partially imbedded in the fireproof material of the inner wall. Between the 40-ft. girders, and supported by them, as shown in the accompanying illustration, are nine longitudinal I-beams, and in the spaces between these beams are set fireproofing tiles, flush with the bottom flanges. Plaster is laid directly on the surface thus formed. As for the heavy, transverse girders, fully one-third of their surface is below the ceiling line, and entirely exposed.

Immediately following the fire, the newspapers gave general publicity to statements that the Manhattan Building, which had suffered serious damage, was a fireproof structure. The above statement shows that this was not the case. Its behavior under the recent test shows, what engineers well understand, that fireproofing the metal framework of a structure over its entire exposed surface is essential if it is to safely withstand the effects of a serious conflagration. It also shows, however, that the elimination of the hollow spaces, which in ordinary wooden buildings form flues which spread and feed the flames, and the use of metal and terra cotta for floors, will greatly retard the spread of fire in a building, even though the fireproofing be imperfectly done.

THE METROPOLITAN CONCRETE AND WIRE FLOOR.

Among the numerous flat and fireproof floors designed for use in modern buildings, in order to allow of greater spans between the floor beams than would be practicable with brick jack arches, and to effect a lighter and cheaper construction than with such arches, is what is styled the "Metropolitan" system, shown in the accompanying cut. Across the floor beams are stretched small wire cables, like



SECTION OF "METROPOLITAN" FIREPROOF FLOOR USED IN TRINITY WAREHOUSE,

fence wires, each composed of two galvanized wires twisted together, the distance between these cables varying according to the load for which the floor is designed. Round bars are then laid across the cables, parallel with the beams, and halfway between them, thus giving a uniform deflection to the cables. Forms, or centers, are then placed under the cables, and a composition, consisting principally of plaster of Paris and wood chips (in proportions of 75 and 25% by weight) is poured on, the cables being thus embedded in the concrete mixture, which solidifies in a few minutes. The vertical part of the concrete, enclosing the floor beams, is supported by wire netting passed around the flanges of the beams. If a flat ceiling is required, iron bars are laid across the bottom flanges of the beams, over which wire netting is laid, and a thinner layer of the composition is poured over this, leaving an air space between the floor and the ceiling. This system of flooring has been extensively used for dwellings, hotels, hospitals and other public buildings, and also in a warehouse, where it has been in use about three years, and has given satisfaction. Over 1,000,000 sq. ft. have been contracted for, of which about 600,000 sq. ft. are in place. The floor is manufactured by the Metropolitan Fireproofing Co., of Trenton, N. J., and we are indebted to Mr. Charles E. Hewitt, President of the company, for the drawing from which the accompanying cut is prepared.

In the construction of a warehouse at Varick and Spring Sts., New York city, for the Trinity Church corporation, the architect, Mr. C. C. Haight, proposed to use this style of floor, but the Department of Building would not authorize its use in this instance until some tests had been made as to its strength, the floor having been used heretofore mainly for buildings in which comparatively light loads had to be provided for. A section of flooring was therefore built in this building, and tested by Mr. Howard Constable, M. Am. Soc. C. E.

The floor beams are 15-in. I-beams, 7 ft. 1 in. apart, as shown in the cut, and the composition filling between them is 5½ ins. thick. The beam flanges are protected by a coating of the composition 1 in. thick. The cables are composed of two strands of No. 12 wire, and are continuous over six spans, being secured at the ends to loops of heavy wire hooked over the top flanges of the beams. The cables are spaced 1½ ins. apart, and their deflection in each span is regulated by an iron bar ½ in. square. The weight of this floor is about 24 lbs. per sq. ft., and it is designed to carry a live load of 170 lbs. per sq. ft. The length of the piece of floor tested was 12 ft., parallel with the floor beams, and Mr. Constable had parts cut out, leaving four sections 7 × 5 ft. (in adjacent spans), to sustain the weight. The following particulars of the tests have been furnished to us by Mr. Constable:

Section No. 1 was tested by a weight of 155 lbs. falling 6 ft., and this weight went completely through the floor at the eleventh blow. On the same section, the same weight falling 10 ft. went completely through at the fourth blow.

Section No. 2 was tested by loading the half span up to 100 lbs. per sq. ft., giving an eccentric loading, but when the weight was removed the floor was uninjured, and returned to about its original position.

Section No. 3 was tested by a uniform loading up to 740 lbs. per sq. ft., the floor deflecting 9-16 in. at the center (and causing a slight rise in section No. 2), but returning 7-16 in. when the load was removed. This section was then reloaded in the same way up to 1,500 lbs. per sq. ft., or nearly 27 tons on the section 7 × 5 ft. This destroyed some of the concrete filling above and below the sustaining wires, but none of the wires broke, and none of the pig iron weights were forced through the floor.

Section No. 4 was tested by having a hot fire maintained underneath it for about an hour, the fire being in a brick furnace immediately under the floor, with a chimney made of the fireproofing material passing up through the section of floor. The temperature of the beams increased only 2° F. Water from the fire hose was then turned on to the bottom and top of the floor, but none of the filling broke loose. The next morning this section was loaded to 1,000 lbs. per sq. ft., without injury to the floor.

PERFORMANCE OF THE STEAMER "CITY OF LOWELL."*

By James E. Denton, M. Am. Soc. M. E.**

This boat has a carrying capacity for 600 passengers and 420 tons of freight, and runs on Long Island Sound nightly between New York city and New London, a distance of 120 statute miles. She was constructed and fitted with machinery by the Bath Iron Works, Maine, the hull being built on designs by A. Cary Smith, of New York.

The tests were carried on during the regular service trips between May 28 and 31. The boat had her bottom cleaned and screws straightened, and was fitted with water meters, on May 24, and returned to service May 25. On May 28, from New York to New London, a preliminary trial of indicators and meters was made. On May 29 the indicated power of the main engines, their water consumption, the boiler economy with five boilers in use, and the speed over a course of 16.45 statute miles, were measured, at about 107 revolutions per minute, which is the slowest service speed, and is within the capacity of four boilers.

On May 30 the indicated power, the water consumption, and speed were determined at 126.86 revolutions per minute, which was maintained over a course of 16.45 statute miles, with six boilers. This corresponds to a still-water speed of 22.19 statute miles per hour, the maximum speed which was attainable with natural draft for a short distance.

On May 31 the indicated horse-power, water consumption, and boiler economy were measured at 111.2 revolutions per minute, which corresponds to the average service speed with five boilers burning buckwheat coal.

The conclusions drawn from the data of the trials are:

(1) The coal and feed-water tests show that about 8 lbs. of water is evaporated per lb. of buckwheat coal, consumed at the rate of about 17 lbs. per hour per sq. ft. of grate, which is sufficient for the ordinary service speed of about 20 miles per hour, using five boilers. This is an excellent performance, considering the character of the fuel.

(2) The feed water used per horse-power of the main engines for all purposes is 18.63 lbs. per hour under ordinary service conditions of about 20 miles per hour, when about 3,000 I. HP. are developed by the main engines, with about 10 expansions, and with 155 lbs. boiler pressure, throttled to 115 lbs. initial pressure in the h.-p. cylinder; and 17.5 lbs. per hour at the maximum speed of 22.2 miles per hour, when about 4,350 HP. are developed in the main engines, with about 10 expansions and 153 lbs. boiler pressure, with the throttle wide open, so that the initial pressure in the h.-p. cylinder is 143 lbs.

The consumption of the auxiliary machinery and leakage were probably 13.6% and 11.25% of the total feed water for these two conditions, respectively, so that the corresponding feed-water consumption of the main engines and their attached air and bilge pumps was probably 16.1 and 15.16 lbs. of feed water per hour per HP. The latter figures, while presenting no novelty for the type of engine tested, indicate a degree of economy equal to that of the best precedents, using steam with about 10 expansions and 150 lbs. pressure.

(3) The fact that at a speed of 22.19 statute miles per hour the I. HP. per net ton of displacement was only 1.58, indicates either that the efficiency of the propelling machinery was exceptionally high, or that the resistance of the hull to passage through the water was exceptionally low. The curve of horse-power plotted on the speed of boat, between 18.50 and 22.19 statute miles per hour, indicates that the horse-power varied as the speed to slightly less than the 2.95 power.

As the slip, engine friction, and waste, through loss of thrust, etc., were probably a practically constant surface formula, using 1.95 as the exponent of the speed it may, therefore, be assumed that the tow-line resistance of the hull may be calculated by the augmented surface formula, using 1.95 as the exponent of the speed in knots.

It then follows that for a speed of 22.19 statute miles per hour the tow-line horse-power would be 64% of the indicated horse-power—that is, that the efficiency of the entire system would be 64%. The possibility of such a high efficiency with screw systems of propulsion has been established by Yarrow's dynamometric experiments with one of his torpedo boats with a single screw.*

Assuming that the coefficient of friction between the water and the blades of the screws was 0.004—which is a little higher than the value regarded as applicable, from Froude's experiments, to the polished bronze four-bladed propellers finally adopted with the British twin-screw despatch boat "Iris"—and assuming that the wake factor was 0.05—which corresponds to Froude's determinations for a boat having the block coefficient of the "Lowell"—it is shown by the application of Rankine's theory of the action of propellers to the data of the "Lowell" for a speed of 22.19 statute miles, that an efficiency of 64% is consistent with an engine friction, including the load of the air pumps and attached bilge pumps, of 18.26% of the I. HP., and a loss of power by the slip and friction of the screws, etc., of 17.4% of the I. HP.

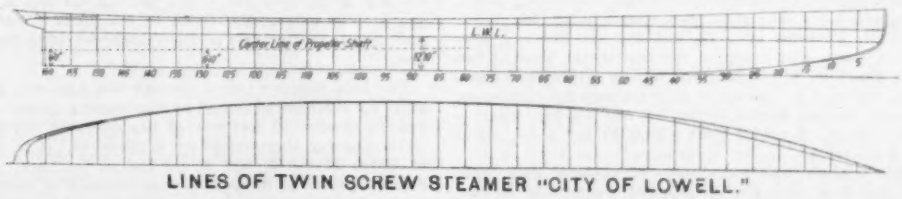
These results indicated that the loss of power by the friction of the main engines, etc., was within the limits which are considered to apply to such machinery, and that the efficiency of the screws reached the unusually high value of 78.3%. It may, therefore, be fairly concluded that the tow-line resistance of the hull at 22.19 statute miles per hour did not exceed the amount which corresponds to 64% of the I. HP.

It then follows, by Froude's skin-resistance formula, that the wave resistance of the boat was only 39% of the total resistance; or that the value of b_6 in Taylor's formula for resistance has the exceptionally low value of 0.24.*

We have then the power distribution as follows:

Indicated horse-power	1.000	.....
Power delivered to propeller (efficiency of machinery)	0.817	1.000
Power to tow hull (efficiency of whole system)	0.640	0.783 Eff. of screws.

It appears, therefore, that the two factors in the performance of the "Lowell" which are principally responsible for her very economical amount of power per ton of displacement are the high screw efficiency and an exceptionally low hull resistance.



LINES OF TWIN SCREW STEAMER "CITY OF LOWELL."

The lines of the hull of the "Lowell" do not present as sharp an angle at the bow as is common in the

* Condensed from a paper read at the New York meeting of the Society of Naval Architects and Marine Engineers, Nov. 7, 1895.

** Professor of Experimental Mechanics, Stevens Institute of Technology.

* "Transactions British Institution of Naval Architects," Vol. XXIV., 1883, page 111.

* Total resistance $= 0.0092 \times \left\{\begin{matrix}\text{wetted}\\ \text{surface}\end{matrix}\right\} \text{knots}^{1.95} + b_6 \frac{\text{(displacement }^{2}/_{3})}{\text{length}} \text{(knots)}^4$. "Taylor's Resistance and Propulsion of Ships," page 137.

average American smooth-water steamboats; but, as will be seen by the accompanying cut, they differ from the latter in providing a rapid decrease of draft from about amidships to bow, and the value of the midship section coefficient is much lower. For example, the steamer "Mary Powell" has a sharper angle of entrance than the "Lowell," as measured by the coefficient of augmentation in the ratio of 1.08 to 1.12, but she has a nearly uniform draft from amidships to bow, and her amidship section coefficient is 0.89 and her block coefficient 0.59; while the corresponding figures for the "Lowell" are 0.761 and 0.434, respectively.

The visible disturbance created by the passage of the "Powell" through the water has been considered to be the practical minimum, but her resistance at 19.15 statute miles per hour (the highest speed for which there is any record of her indicated power*), estimated on her augmented surface, corresponds to the 1.95 power of the speed for 64% efficiency, and the exponent for any other efficiency between 0.55 and 0.75 is higher than that for the "Lowell" at 22.19 statute miles per hour and the same efficiencies. In other words, the resistance to propulsion of the hull of the "Lowell" is no greater at 22.19 statute miles per hour than that of the "Powell"† at 19.15 statute miles per hour.

Dimensions and Particulars.

Hull.

Beam, L. W. L.	48 ft.
Draft during trials (both forward and aft).	12 ft. 10 ins.
Length over all	336 ft.
Length on L. W. L.	319.9 "
Displacement	2,738 net tons.
"	2,445 gross tons.
Midship section	467 sq. ft.
" " ÷ beam × draft	0.761
" " coefficient	0.761
Coefficient of fineness	0.572
Block coefficient	0.434
Wetted surface	13,855 sq. ft.
Augmented surface	15,399 " "
Coefficient of augmentation	1.12

Main Engines.

The engines are of the common, inverted, marine type, without jackets. The h.-p. cylinders have a single-piston valve, and the intermediate and l.-p. cylinders have slide-valves, all of which are driven by link motions.

An air-pump and a small bilge pump are connected to each engine.

	High.	Inter.	Low.
Number of cylinders	2	2	2
Diameter of cylinders, ins.	26	40	64
" " piston rod, ins.	5⅝	5⅝	5⅝
" " tail rod, ins.	4⅜	4⅜	4⅜
Stroke, ft.	3	3	3
Horse-power constant	0.003	0.225	0.581
Ratio of volumes of cylinders	1.00	2.42	6.25
Clearance, % of piston displacement.	1.05	0.40	0.21
Port area, sq. ins., admission	96	140	321
" " " " exhaust	107	203	424
Surface condenser, sq. ft.	...	3,387	...

Boilers.

The boilers are operated by the natural draft of the chimneys, but the fire-room is supplied with air by a fan for ventilating purposes.

Number of boilers	6 Scotch, marine type.
Diameter of boiler	13 ft. 6 ins.
Length of boiler	12 " 5¼ "
Number of furnaces per boiler	3
Grate area per boiler	75 sq. ft.
Water-heating surface per boiler	2,536 " "
Surf. in f'd-water heater in uptake, each blr.	56 " "
Ratio of heating to grate surface	33.8
Number of chimneys	2
Cross-section of each chimney	7 ft. × 8 ft. 2 ins.
Height of chimney above grate	53 ft.
Width of opening in grate bars	½ in.
Ratio of air space to grate	0.35

The auxiliary machinery consisted of two straight-line, simple electric light engines, 11 × 14 ins.; two boiler feed-pumps, simple duplex, 10 and 7 ins. diam. × 10-in. stroke; two simple centrifugal circulating pump-engines, 6 × 6 ins.; one duplex simple pump, for water-closets, kitchens, etc., 4½ and 3¾ ins. diam. × 4-in. stroke; one simple engine for centrifugal blowing fan for fire-room, 4 × 7 ins.; one duplex Williamson steering engine, 7 × 7 ins.; one duplex pump for circulating water through engine slides, 5¼ and 4¾ ins. diam. × 5-in. stroke; 1 duplex bilge pump, 10 and 6 ins. diam. × 10-in. stroke.

The screws have four blades of uniform pitch, cast to the hub, and are of polished manganese bronze, with sharp edges.

Outside diameter of blades	11 ft. 1 in.
Diameter of hub	23 ins.
Pitch	16.63 ft.
Area of blades proj'd on athwartship plane.	33.56 sq. ft.
Developed area of blades	46.86 " "
Immersion of top of disk at 12 ft. 10-in. draft	16 ins.

Both screws turn in the same direction.

* Tests by Isherwood, Journal Franklin Institute.

† The dimensions of the "Mary Powell" are: Length, L. W. L., 284 ft.; draft, L. W. L. to rabbet of keel, 6 ft.; beam, L. W. L., 33.58 ft.; displacement, 940 net tons; augmented surface, 7,980 sq. ft.; indicated HP. at 19.15 statute miles per hour, 1,560.

The Sawyer-Mann patent for the combination in an incandescent lamp filament of carbonized fibrous and textile materials has been declared invalid by Justice Brown, of the U. S. Supreme Court. Justice Brown stated that Sawyer and Mann had confined their experiments to carbonized fiber and charcoal, while Edison and his assistants had examined 6,000 articles in their search, and finally fixed upon the cuticle of a species of bamboo as the best material for the conductor. Sawyer and Mann then abandoned the materials they had used, and adopted the special material discovered by Edison. Their claim that their patent was broad enough to exclude Edison's discovery, and make his use of it an infringement, could not be maintained, said Justice Brown, as this claim was entirely too broad, and the patent is declared invalid. This decision throws both systems open to the public, as the Edison patent expired just one year ago under the decision in the Bate refrigerating patent case.

Suits to prevent the further pollution of the Juniata River by the sewage of Altoona have been brought against that city by the authorities of the boroughs of Gaysport and Hollidaysburg and private individuals on the river below Altoona. It is said that an investigation of the river has been made by Dr. W. E. Matthews, an inspector appointed by the State Board of Health, and that his findings are at least a partial basis for the suit.

The proper maintenance of our warships now in commission, says Chief Constructor Hichborn in his last report, would require $1,500,000 this year, whereas only $900,000 is appropriated by Congress. The repair appropriation for several years past has been limited to less than 3% on the original cost of the vessels, while in the British navy this item is figured at from 4 to 9%, the lower figure applying to the heaviest armored ships. Mr. Hichborn recommends new dry-docks at Portsmouth, N. H.; Boston, Mare Island, Cal., and at Norfolk, Va. Chief Engineer Melville and Chief Constructor Hichborn concur in an estimate of $5,895,679 that must be provided for next year, on account of vessels authorized by Congress, but for which no appropriations were made. Mr. Hichborn again asks for $100,000 with which to build an experimental tank for testing the models of warships previous to construction. Chief Melville, in his annual report, recommends the replacing of the now obsolete horizontal compound 4,030-I. HP. engines of the "Atlanta," authorized in 1883, with engines of 5,400 I. HP., fitted to twin screws instead of a single screw. This would cost about $200,000, and the same change should be made in the sister ship "Boston" after her next cruise has expired. The cruiser "Olympia," built in 1890, is reported as having made an average cruising speed of 10 knots per hour for the 3,440 miles between Honolulu and Yokohama.

The new battleship "Texas" is reported as having been seriously strained in the docking operation at the Brooklyn Navy Yard. An inquiry is being held, and meanwhile various causes are ascribed for this accident. Among these are the following surmises: Inexperience in docking heavy battleships, or lack of strength in frames due to the attempt to lighten the ship. In support of the latter theory, it is stated that in first filling her boilers at the Norfolk yard they settled upon their supports, and additional braces were added to carry the weight. The present damage reported includes the buckling of 21 bottom frames and brackets, from ¼ to 1½ ins., and the cracking of the cement lining in the double bottom.

A railway with wooden rails 32 ft. long, 8 ins. wide, and 6 ins. deep, secured by 18-in. wooden pins to wooden splicing pieces, 4 ft. long, placed under the joints, is being built by the Avon Park Transportation Co., from Avon Park, Fla., to Haines City, on the South Florida division of the Plant railway system, a distance of 38 miles. Mr. Clark D. Knapp is President, and Mr. J. C. Burleigh is Superintendent of Construction.

The Jura-Simplon tunnel through the Alps will probably be commenced early in the coming year. The Federal Council of Switzerland has approved the plans of its Railway Department for a tunnel 64,714 ft. long, of which 27,000 ft. will be on Italian territory. The Swiss legation at Rome has been directed to conclude as speedily as possible the negotiations now in progress for calling an international convention, which is to regulate questions of construction and operation of the tunnel.

The first example of the application of the "booster" system in electric railway work is the installation made a few months ago on the line of the Chester Traction Co., at Chester, Pa. It was found that the amount of copper on the line was altogether inadequate, especially in the eight and seven-mile branches to Darby and Media, respectively, where the Sunday and holiday summer traffic is very heavy, and an outlay of $20,000 in new feeder wire was contemplated by the company. Before making this, however, it was decided to try the booster system, and two generators of 100 and 150 KW. capacity, respectively, which had been thrown into idleness by the installation of a new 400-KW. dynamo, were placed upon the feeder circuits as boosters for the two lines above mentioned. These machines were not designed for the purpose, but no difficulty was experienced in making their action automatic. This action consists in raising the initial voltage above that of the bus-bars by an amount equal to the drop in potential on the feeder, this amount varying constantly and widely. The booster system has been in successful use in electric lighting work for a number of years, and it is said that the success attained in the case under discussion is such as to warrant a general adoption of the system for long distance railway work. It is stated that at the Darby terminus an almost constant pressure of 500 volts is maintained, with the booster in operation, while loads vary from zero to 450 amperes. Without the booster, one car, when climbing the hill near Darby, would reduce the voltage to 275.

A new and hitherto unsuspected cause of fire in factories is reported in the list of fires and losses in September, issued by the Boston Manufacturers' Mutual Fire Insurance Co. The destruction of the mills of the Warren Mfg. Co., at Warren, R. I., is said to have been caused by the ignition of the wooden lagging of the high-pressure steam cylinder of a compound steam engine, working under 120 lbs. pressure. The circular of the insurance company advises each treasurer and mill owner to protect every engine room with automatic sprinklers without delay.

The Browning automatic gun, of .236 in. caliber, has been successfully tested at Indian Head. This is an American rapid-fire gun, reported by Lieut. N. E. Mason, U. S. N., in charge of test, as being remarkable for simplicity and strength of mechanism, and ease and rapidity of action. The Browning gun consists of a single barrel of .236 in. caliber, with a breech casing for the firing and ejecting mechanism. This gun is mounted on a support with a horizontal pivot for raising or depressing it, and the support has a vertical pivot fitted into a light gun-carriage, or in sockets provided on the rail or mastheads of ships. The cartridges are fed from belts coiled in boxes, attached to the breech-casing, containing 100, 150 or 500 cartridges. The gun weighs 40 lbs., and the tripod and mount 70 lbs. The automatic action is effected by means of the pressure of the powder-gas in the barrel after the projectile has attained its maximum velocity. In the tests referred to, over ranges of 500 and 1,000 yds., 1,053 cartridges were exploded, with one miss-fire only, and 400 rounds were fired in 1 m. 49 s., 20 rounds in 4 s., 80 rounds in 14 s., 100 rounds in 23 s. and 200 rounds in 34 s. The gun worked satisfactorily throughout, with only two brief stops in the firing. With the barrel revolving, 200 rounds were fired in 47 s. The firing was not as accurate as could be desired, owing to the uneven pressure of the powder-gas causing the bullets to strip and tumble, and the temperature developed was high, but no serious accidents occurred.

The water supply of Long Island has lately been investigated by Mr. N. H. Darton, of the U. S. Coast and Geodetic Survey, and his report is being prepared. According to advance notes, Mr. Darton finds the Island to be made up of glacial drift containing stored rain-water in large quantities; but, owing to the peculiar and irregular arrangement of this drift, this water may be found at depths varying from 30 ft. to 500 ft. He recommends deep wells, and thinks the conditions are excellent for obtaining a considerable supply of water by this means. He says that while there are a great many sheets of water scattered through the sands and drift at various depths their relations are so irregular that no definite statement can be made as to their location.

A new metropolitan water supply for London is being considered by the Special Water Committee of the London County Council. Mr. A. R. Binnie, the engineer of the council, estimates the cost of a daily supply of about 500,000,000 U. S. gallons from mountain sources in Wales at about $190,000,000. This supply would be adequate for the next 50 to 60 years, and but part of it need be provided now. Before the County Council can build and operate works, if it ever does, it will doubtless buy out the eight water companies which now supply London. It is said that the companies demand considerably more than $100,000,000 for their combined plants.

The Trenton Falls water power project is being examined by Mr. Wallace C. Johnson, of the Niagara Falls Hydraulic Power & Manufacturing Co. These falls are in Oneida county, N. Y., on West Canada Creek. There are six of them in a distance of two miles, with an aggregate descent of 312 ft. The development of power and electric transmission are included in the present project.

The power dam now being built at Portage, Canada, across the Winnipeg River, and at the outlet of the Lake of the Woods, will raise the water in the lake 4 ft. It is claimed that this dam will cause an overflow into what is called the Great Swamp and flood about 70,000 acres of timber and agricultural lands in Beltrain and Rosseau counties, Michigan. Agents of the United States are now investigating the reported damage to arise from the completion of this dam upon which, it is reported, $600,000 has already been expended.

An artificial island in the Alster basin, near Hamburg, which was built for the accommodation of the Emperor and other dignitaries, on the occasion of the formal opening of the Baltic ship canal, last year, is described in a recent communication. The island had an area of 5,800 sq. meters and was built entirely on piles. Artificial rocks were made by covering a framework of expanded metal with red plaster. In a photograph of the island these rocks have a distinctly "stagey" appearance, hardly in keeping with the natural wooded banks of the river in the background. The island contained a small building for the Emperor and a second and larger one for the invited guests. At one end stood a lighthouse or signal tower. A unique feature of the island was the arch at the landing place, consisting of the immense jaw of a whale.

The labor strikes of 13 years, from 1881 to 1894, have been reported upon by the Commissioner of Labor. The report is very detailed, and is compiled from press reports and a careful canvas of manufacturing establishments and the records of labor organizations. Condensed, the statement may be tabulated as follows for the years 1881-1894:

Number of strikes	14,390
Establishments affected	69,167
Employees thrown out of work	3,714,406
Per cent. estab'm'ts where strikes succeeded	44.49
Wage loss of employees, from strikes	$163,807,866
" " " " from lockouts	28,685,516
Loss to employers, from strikes	82,590,386
" " " from lockouts	12,235,451
Paid out by labor organizations, in addition to above loss to employees	4,590,177
Percentage of women strikers in 13 years	8.78

The Philadelphia Economic and Commercial Museum has been established in that city under the active charge of Prof. W. P. Wilson, the head of the Department of Biology of the University of Pennsylvania. This museum, the first of its kind in the United States, is intended as a classified depository of the raw materials and manufactures of all countries, and to this end the exhibits of the Spanish-American and some other countries of the Chicago Exposition have already been secured. The aim of the institution is to afford the means for intelligently studying the needs of foreign markets, with a view to the extension of American trade. A bureau of information is being added; and it is the intention to not only enlist the services of American consuls in this work, but to establish a corps of trained correspondents at all foreign trade centers. The aims of the institution are widespread, and if well carried out they should have a most important effect upon the general foreign commerce of the country. But its successful operation will depend entirely upon the degree yith which it meets with encouragement from those whom it is intended to benefit.

The Johnson platform car-fender, used in Boston on the West End system, seems to have made a much better record than has been the case with practically the same device in use on the Brooklyn electric railways. A report made some months ago by Prof. George F. Swain to the Massachusetts Railway Commission has been brought up to date by General Manager Sargent, of the West End Company, and from it we take the following figures: From Oct. 2, 1892, when the fender was introduced, to Oct. 14, 1895, the record is as follows: Persons in collision with fenders, 347; escaping unhurt, or with slight injuries, 301, or 86.7%; receiving more serious injuries, 40, or 11.5%; killed, 6, or 1.7%; electric car-miles in the three years, 52,700,000; equivalent to an average of 8,783,333 car-miles for each fatality caused by collision.

A suspension bridge is to be constructed across the Ohio River at Rochester, Pa., according to the Pittsburg, Pa., "Times." The bridge will carry highway and street railway traffic, and will be 2,300 ft. long over all, with a center span of the suspension type 800 ft. long. The structure was designed by Mr. E. K. Morse, of Pittsburg, Pa., who is quoted as making the following statement regarding the design:

In designing this bridge I aimed to plan a structure that would have the maximum stiffness under the severest strains, coupled with the fastest speed our heaviest street cars now necessitate. With this in view, I have made my stiffening truss, which the cables support, deeper at the towers than at the center, which gives it the appearance of a cantilever, and, instead of making the expansion joints at the towers, the trusses will be riveted at top and bottom firmly to the towers, and a slip-joint will be placed at the center of the channel span and at the ends of the two flanking spans, which are each 400 ft. long. All wind strain will be taken up and transmitted to the tower, and thence to the masonry, by a system of stiff laterals riveted to the beams and stringers. The trusses are 18 ft. deep, except at the towers, where they are 28 ft. deep; are T-formed in section, and of the same area throughout the length of the bridge

The bridge is estimated to cost $175,000, and is to be built by a private company, of which Mr. A. J. Jolly, Pittsburg, Pa., is President.

ANNUAL MEETING OF THE SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS.

The third annual meeting of this Society was held at the rooms of the American Society of Mechanical Engineers, 12 West 31st St., New York city, on Thursday and Friday, Nov. 7 and 8. Sessions were held in the morning and afternoon of each day, and a banquet was had at the Hotel Brunswick on Friday evening. The sessions were well attended, and much interest was shown in the reading and discussion of papers. The President, Mr. Clement A. Griscom, called the meeting to order, and the Secretary, Mr. Washington A. Capps, read the report of the council and of the auditing committee. The reports showed that the Society was in a most flourishing condition, with a comfortable cash surplus in the bank. The council reported the election of Mr. Wm. H. Webb as an honorary member, and of Lord Brassey, President of the British Association of Naval Architects, as an honorary associate member. The council also reported favorably upon several candidates for election as members and associates, who were thereupon elected. The election of officers for the next year then took place. All the present incumbents were re-elected, Mr. John F. Holloway being elected an additional member of the council.

The President then read his annual address. He congratulated the Society upon its rapid growth to a membership of over 500. In the course of his remarks he said:

Our society is the natural outgrowth of the public sentiment that has made our new navy possible, which sentiment, I am sure, will never be satisfied until our flag protects a mercantile marine commensurate with our position as a nation.

It should be a subject of national humiliation that so small a percentage of our foreign commerce is carried under our own flag. While millions are being spent for our defense on the seas, and many more are sure to follow, curiously enough our country has been content to pay hundreds of millions as tribute to the nations who have seized our foreign commerce and fixed the price at which we must sell our products abroad, and the terms at which our citizens must visit foreign countries.

The mission of this society is in no sense commercial, but unless there is a national sentiment that demands a navy, and a proper commercial spirit in the land that demands an adequate commercial marine, why should the art of shipbuilding and naval engineering be encouraged among us?

The product of American shipbuilding during the last year has been a convincing demonstration of the capacity of America to efficiently build ships of whatever size and type, either mercantile or naval, which any nation may require. It must from henceforth be understood that the American shipbuilder is in the market for the trade of the world.

It is also apparent that there is a turning point approaching in the character of the coasting traders, when a company lays down a 5,000-ton steamer with quadruplex expansion engines and water-tube boilers, such as that commenced at Newport News.

The reading and discussion of papers followed the President's address. The list of papers was as follows:

"American Maritime Development," by Capt. Henry C. Taylor, U. S. N., President Naval War College; "Performance of the Twin-Screw Steamer 'City of Lowell,'" by Prof. Jas. E. Denton, Stevens Institute of Technology; "Rudder Experiments—U. S. S. 'Monterey,'" by Elliot Snow, Assistant Naval Constructor, U. S. Navy; "Aluminum—Its Alloys and Their Use in Ship Construction," by J. C. McGuire, Esq., C. E.; "Methods and Forms for Certain Ship Calculations," by D. W. Taylor, Naval Constructor, U. S. Navy; "The Number of Longitudinal Intervals in Ship Computation, as Affecting the Accuracy of Integration for Displacement, and Note on the Relation between Reduced and True Wetted Surface," by Prof. W. F. Durand, Cornell University; "Recent Designs of Vessels for the U. S. Navy," by Philip Hichborn, Chief Constructor, U. S. Navy; "Tactical Considerations Involved in Warship Design," by Albert P. Niblack, Lieutenant, U. S. Navy; "The Centerboard—Its Influence on Design, Its Value and Its Proper Use," by Wm. P. Stephens, Esq.; "Engineering Research in the Navy," by Prof. Wm. S. Aldrich, University of West Virginia; "The Ventilation of Ships," by F. B. Dowst, Esq., M. E.; "An Experimental Test of the Armored Side of U. S. S. 'Iowa,'" by Albert W. Stahl, Naval Constructor, U. S. Navy.

All these papers (except the first on the above list) were printed in advance of the meeting, and were in the hands of the members while they were being read. It seems like a great waste of time to have the author read a long paper, almost in full, when the members have it in their hands. It would be well if this society would adopt the rules of the American Society of Mechanical Engineers, according to which copies of the papers are sent some time before the meeting to all the members who have notified the Secretary of their intention to be present at the meeting, or of their desire to send in a written discussion in case of their absence, and only five minutes are allowed for the presentation in abstract of each paper. Practically, the whole time of the sessions is thus devoted to discussions, and the discussions, being largely thought out or even written out before the meeting, are apt to be of much more importance than the extemporaneous brief discussions which follow the tedious reading of a paper at a meeting.

Captain Taylor's paper was a forecast of the future development of the maritime trade of the United States. He said in the immediate future the development would follow the line of least resistance, and that was not across the Atlantic, but to the southward, in the Caribbean Sea, and along the northern coast of South America. In these parts the United States has the controlling advantage, as against all European marine powers, of shorter distance. The shipbuilders should prepare to take possession of this Southern trade. They should study the ship that is needed for the Caribbean Sea, one that will not only traverse the ocean, but ascend the shallow rivers, and deliver freight in the interior of Colombia, for example, without breaking bulk. After the Nicaragua Canal is opened, a vast extension of our maritime trade is possible, not only to the west coast of South America, but to China and Japan. A map of the northern Pacific Ocean on the gnomonic projection was exhibited, showing that an arc of a great circle extending from San Francisco to northern Japan would touch the Aleutian Islands. A route from New York to Japan, then, can be laid out via the Nicaragua Canal, Mazatlan, San Diego and San Francisco; thence to a coaling station on one of the Aleutian Islands, and thence to Hokodadi, Japan, which will deviate but little from the arc of a great circle from Nicaragua to Japan. Upon the conclusion of this paper, a motion was made by Admiral Meade for the appointment of a committee to prepare a memorial from the Society to Congress praying "that the Nicaragua Canal Company, under the control of citizens of the United States, may receive at your hands such consideration, sympathy and substantial aid as you may deem wise and just." A committee was appointed, which on Friday morning reported in favor of the proposed memorial, but a minority of one, Ex-Engineer-in-Chief Loring, reported adversely. This led to a vigorous debate, in which it appeared that while the members present were, as individuals, unanimously in favor of governmental aid to the Nicaragua Canal, a considerable number of them held that it was not the province of this Society, which is exclusively a technical society for the promotion of the art of shipbuilding, to express any opinion on a subject of this nature or to memorialize Congress upon it. This view prevailed, and the report of the committee was rejected by about a two-thirds vote.

Professor Denton's paper described some trials made to determine the efficiency of the screws and machinery of the twin-screw steamer "City of Lowell," one of the steamers of the Norwich Line from New York to Boston. We have abstracted the paper in another column.

Mr. Snow's paper on "Rudder Experiments on the 'Monterey'" consisted chiefly of tables of figures obtained in the experiments, and it contains no summary of conclusions which can be abstracted. The introduction of the paper is as follows:

The object of the experiments was to determine the twisting moment on the rudder head when using the helm with the vessel under way. To make these trials as comprehensive as possible, it was decided to determine this moment for speeds varying from four to twelve knots, increasing by intervals of two knots, and at each of these five speeds the rudder to be set at angles varying from amidships to hard over, starboard and port, by five-degree intervals.

It was impossible to get any reliable observations with a helm angle less than 15°, and, consequently, the programme, as laid down, was not fully realized.

Mr. McGuire's paper on "Aluminum—Its Alloys and Their Use in Ship Construction," contains a general account of the properties of aluminum, and its alloys, which are well known to engineering readers, together with some important cautions in regard to galvanic action, and a description of the aluminum parts of the yacht "Defender." The following is extracted from the paper:

Too much care cannot be taken, especially in using aluminum around water, salt water in particular, to prevent oxidation by galvanic action. Aluminum stands well at the head in the table of metals arranged in electro-chemical series, thus showing it to be very much more positive than the other ordinary metals which stand much lower in the table. When two metals are in contact, especially in salt water, a voltaic couple is formed, which is equal to the sum of the electro-motive forces between the metals, and when such a couple is formed the most positive element is the one that is attacked the most severely. Aluminum naturally suffers the worst, as it is electro-positive to the ordinary metals of commerce, and shows up badly in comparison.

Each plate used in the construction of the hull of the "Defender" was tested. It can safely be said that, considering the ductility shown, these are the highest tensile tests that have ever been made in any of the alloys of aluminum.

The heaviest plate in the "Defender" weighs about 200 lbs., is 38½ ins. wide, 5-16 in. thick, and 13 ft. 10 ins. long, which is the largest plate of aluminum that has ever been rolled, so far as the author knows.

This plate gave an ultimate tensile strength of 40,780 lbs. per sq. in., an elongation of 10% in 2 ins., and the reduction of area at the point of fracture was 14.75%.

Except for the color, the fracture of these test specimens is exactly like the fracture of a steel specimen of the same size, tested under the same conditions.

In a table of 16 tests of sections about 1½ in. wide by from ¼ in. to ⅝ in. thick, the elastic limits ranged from 25,030 to 37,130 lbs. per sq. in.; the ultimate tensile strength from 36,820 to 43,480 lbs. per sq. in.; the elongation in 2 ins., from 8 to 10.5%; and the reduction of area from 3.4 to 22.7%.

The question of riveting came up when the "Defender" was constructed, and the advice of the author of this paper to the builders was to use aluminum rivets, and he offered to furnish these of the same character and grade of material as that from which the plates were constructed. This advice, however, was not listened to, and the boat was constructed with bronze rivets. It remains to be seen how the plates around these rivets are going to withstand the galvanic action.

The aluminum used in the "Defender" is what is known in the market under the commercial name of the Pittsburg Reduction Co.'s nickel aluminum.

The alloys of copper have been used for this purpose abroad, and seemed to have given satisfaction there, but the results of experiments seem to show that the use of 6% copper (which is what Yarrow used in constructing the torpedo boat which he built for the French government) did not give an aluminum sheet which was either as strong or as ductile as that from which the plates above referred to were made.

The plates used in the "Defender" vary from ¼ to ⅝ in. in thickness, the majority of them being 5-16 and ⅜ in. She is constructed of aluminum plating from her water-line up, which, amidships, gives an aluminum belt a little over 4 ft. wide.

Her deck beams are of aluminum, being composed of 5-in. bulb angles, being 5 ins. on one leg and 2½ ins. on the other, 5-16 in. thick, weighing in aluminum 3½ lbs. to the foot.

All of the lateral and diagonal braces under the deck are aluminum plates about ⅜ in. thick. There is also an aluminum stringer plate, about 2 ft. wide, which connects the deck beams with the side of the vessel, and is continuous throughout the length of the vessel.

The rail of the "Defender" is also composed of a 5-in. bulb angle of the same size as described above, the 2½-in. flange being riveted to the stringer plate above described, and the 5-in. leg having the same level as the side of the vessel at the point where the two join. From this it will be seen that at the stern of the boat it was necessary to open this angle out until the two flanges were almost in a straight line. This was done without any sign of fracture on the inside of the angle. The dead-light frames and covers which are placed in the deck are also constructed of aluminum, as well as the lanterns, and also many of the small interior fittings.

Her blocks are of wood, with aluminum sheaves, and they have given great satisfaction, the sheaves being stronger than those constructed in a similar manner, which were used on the "Vigilant," these latter being made from composition and wood. The binnacle is aluminum, as is also nearly all of the metalwork on the boat in connection with the plumbing and closets.

It will thus be seen that the main object which the designers wished to accomplish was to get a boat which was not only as light as possible, but which would have its center of gravity as low as was practicable, yet, at the same time, to have no aluminum on the outside below the water-line, owing to the fact that aluminum fouls when exposed to salt water, and collects barnacles very nearly as rapidly as iron or steel.

Naval Constructor D. W. Taylor's paper on "Methods and Forms for Certain Ship Calculations" relates to the calculations for displacement, water-line areas, center of buoyancy, locus of meta centers, and the like. It is limited to arithmetical methods, integrating instruments not being considered, and discusses at length the relative merits of the trapezoidal rule and Simpson's rule for areas.

The two papers of Mr. Durand are of a similar nature to that of Mr. Taylor, and discuss the several methods of calculating displacement and wetted surface and the probable errors of each method.

The paper by Chief Naval Constructor Philip Hichborn presented arguments in favor of a comprehensive programme for obtaining a homogeneous and effective fleet peculiarly adapted to American necessities. Special limitations, he said, are imposed by the geographic and hydrographic considerations on naval design in this country. We have gradually settled down to seagoing battleships, low freeboard harbor defense armorclads, armored cruisers, gunboats and torpedo-boats as the types required, and with this classification as a general guide we have continued to gradually build up our fleet, but, until recently, with too much emphasis on cruisers and too little regard for the real fighting machine of naval warfare—the properly armed and armored battleship—which must, in any naval war, be it one of offense or defense, bear the brunt of battle. Cruisers are extremely serviceable in peace, and have a definite and useful function in war, but they will not decide battles. Coast defense vessels and torpedo-boats are vitally important in defending a harbor or dislodging an enemy after he has obtained an entrance, but it is alone through battleships that an enemy can be met and vanquished before he has even sighted our coast, and through battleships alone that any successful demonstration may be made against the enemy's principal seaports, and thus, by taking a vigorous offensive, carrying out the most effective scheme in defense. In a word, battleships are the real bone and sinew of any naval force, and no maritime country can be great in offense or defense without fully accepting this almost axiomatic statement.

Lieutenant Niblack's paper on "Tactical Considerations Involved in Warship Design" discusses the methods of interior communication between the conning towers and the several working departments of the ship, exterior communication or signaling between the several vessels of the fleet or between the naval and land forces, tactical qualities of ships, and methods of movement in battle. His conclusions are summarized as follows:

Ample means of interior communication and ample protection to flag-officers and captains should be provided; every known method of signaling between ships should be available for battle; additional facilities should be furnished ships for handling them in drill in time of peace, so that officers may be better able to dispense with them in time of war; the craze for speed is the curse of modern naval architecture, although it has led to wonderful improvements in steam engineering; turning power is all-important to a ship; standard types of ships and standard fittings should be decided on by a new policy board; the building programme of warships should not include any more so-called cruisers; in the incipient stages of the design, the tactical requirements should be given full and careful consideration, not leaving them, as is too often the case, to be fitted in as an afterthought, when the vessel is nearing completion, and when the designer has little latitude in the arrangement of bridges, signal stations, etc.; and, finally, our battle tactics should be thoroughly renovated, and formulated in conjunction with a continuous programme of shipbuilding in which the ships should be built to suit the tactics, and not the tactics continually modified to suit the infinite variety of ships turned out under the fallacy of constantly "improved" types, and with turning circles, coal capacity, and tactical qualities in infinite variety.

Mr. W. P. Stephens's paper on "The Centerboard—Its Influence on Design, Its Value and Its Proper Use," is a discussion of the merits and demerits of the centerboard, both in its relation to racing yachts and in relation to vessels of other classes. His principal conclusions are the following:

Were we to assume that Mr. Burgess, in designing "Puritan," "Mayflower" and "Volunteer" had been denied the use of the centerboard and compelled to rely upon the keel type alone, in each case, with the current yachting knowledge of the day to guide him, the probabilities are that the American yacht in each case would have been so superior in sail area, in power of hull through added beam, and especially in the area and effectiveness of the lateral plane, that the cup would still have been on this side. The keel has held the cup this year; "Vigilant" might well have been a keel boat and yet won in 1892; "Volunteer," with no centerboard, but with 3 ft. more draft, 13 ft. instead of 10, would still have defeated "Thistle"; in other words, recognizing now the marked defects of the British keel yachts "Genesta," "Galatea," "Thistle" and "Valkyrie II." they were really beaten by superior power, and not by the mere use of the centerboard.

In conclusion, while the centerboard has been at times an instrument of evil through the easy way which it opens to bad design and construction, the device, when properly handled by the honest and skillful designer, is of the highest possible utility. Through it is made possible a craft of extremely light draft which, though capsizable, is still reasonably safe and exceedingly useful in skilled hands, and no other should attempt to use it. With adequate depth and a proper construction, the material being preferably all metal in large craft, it gives a strong, safe, and practically non-capsizable sea-going vessel, for either pleasure or trade, on a moderate draft of water. The best possible combination of good qualities—speed, safety, accommodation, and convenience of use—are to be had in a yacht in which the greater part of the depth is made up by the hull proper, the keel or appendage being reduced to a minimum (for the sake of light draft), and the main factor of lateral resistance being a centerboard properly proportioned to the hull and placed in the one correct position. As in most of the details of yacht designing, the location of the centerboard is not a matter of exact calculation, but of judgment based on practical experiment and close observation.

Professor Aldrich's paper on "Engineering Research in the Navy," was chiefly an argument in favor of the establishment of state engineering laboratories at the Land Grant colleges, or state universities, and also at the U. S. Naval Academy. The paper concluded as follows:

All of these state and Naval Academy engineering laboratories should be under the supervision of the general government, and in much the same organized manner that the whole system of agricultural experimental stations are now developed. That is to say, there should be a Bureau of Engineering Laboratories in the U. S. Navy Department, bearing the relation to the naval and state engineering laboratories that the Office of Experiment Stations in the U. S. Department of Agriculture bears to all of the state agricultural experiment stations. The several heads of departments, or directors of these state engineering experimental stations, should have advisory and co-operative relations with the heads of government bureaus.

It is by the establishment of a national engineering laboratory, however, that the whole work of scientific engineering research will be most advanced. It is to this end that we are tending. No branches of the government service will be so materially promoted as those of naval architecture and marine engineering. It may be possible to secure an act of Congress for the national engineering laboratory earlier than for the state laboratories. But, however that may be, the future will develop. The fact remains that all such work must, earlier or later, receive organized government aid and endowment, in state as well as in national institutions, and we cannot better close the line of argument for the joint establishment of these than by paraphrasing a portion of Senate Bill 3,824, which was unanimously approved by Select Committee, and recommended for passage March, 3, 1893, this bill providing for the establishment of a National University at Washington. Only such an institution could, in any proper sense, complete the now incomplete system of federal aid to engineering education and most wisely direct all worthy efforts in the field of original research, and properly utilize the facilities for such research, which are so rapidly accumulating at Washington. Such a measure should provide for the establishment of a national laboratory of the highest type, holding to the other nationally-endowed engineering laboratories relations similar to those held by the latter in reference to private laboratories and those connected with manufacturing establishments; a national engineering laboratory whose facilities should be open to all who are competent to use them, and whose several heads of departments should have advisory and co-operative relations with the heads of government bureaus, as well as with the state, naval, and other nationally-endowed engineering laboratories, for the mutual advantage of the government itself and the cause of universal science.

Mr. Dowst's paper on "Ventilation of Ships" treats of the difficulties encountered in properly ventilating a vessel, and of the several methods of forced ventilation. He gives the following method of calculating the quantity of air to be delivered to a room:

If the volume of carbonic acid in 10,000 parts of the entering air be taken as 4, and the volume of carbonic acid admissible in 10,000 parts as 6, the quantity of air to be supplied per person is 3,000 cu. ft.

If it is desired to maintain a standard of s parts of carbonic acid in 10,000, we find the required air supply per hour $A = \frac{6{,}000}{s-4} n = 1{,}500\ n$—that is, 1,500 cu. ft. of fresh air per inmate per hour.

In this way the following table is computed:

Cubic feet of air with 4 parts of carbonic acid in 10,000 per person per room to keep air in room at composition of—

6	7	8	9	10	15	20
Cu. ft.	Cu. ft.	Cu.ft.	Cu.ft.	Cu. ft.	Cu. ft.	Cu. ft.
3,000	2,000	1,500	1,200	1,000	545	375

The quantity of air to be delivered to the occupants of a room to dilute the air to a standard of purity, the only pollution arising from the inmates, may be determined as follows:

Let A = volume of fresh air to be supplied per hour.
a = cu. ft. of CO_2 in each 10,000 ft. of entering air.
b = cu. ft. of CO_2 in each 10,000 ft. to which the air is to be diluted.
n = number of occupants.
.6 = cu. ft. of CO_2 exhaled by one person per hour.

Then $\frac{A \times a}{10{,}000} + 0.6n$ represents total cu. ft. of CO_2 delivered per hour to the room, and

$$\frac{10{,}000 \left\{ \frac{A \times a}{10{,}000} + .6n \right\}}{A}$$

should equal the desired standard of purity; so we place it equal to b and find that $Ab = Aa + 6{,}000n$, and

$$A = \frac{6{,}000n}{b-a} \qquad (1)$$

The ideal system for ventilating a ship would contemplate a blower for forcing air into the ship under the plenum system, and an exhaust fan for exhausting the air from the ship under the exhaust or vacuum system, the two operating in conjunction; but where only one form of systematic air supply is to be used, the preferable arrangement is the exhaust system, where the work to be done is purely that of aerating or ventilating.

Where it is desired to obtain a cooling effect in compartments where there are large sources of heat, as boiler rooms, dynamo rooms, etc., the best effect is obtained by the plenum system, delivering a very large volume of air to the compartment, the quantity of supply having no reference to vitiation of the air, but being made with the view of changing the air as frequently as possible, and arranging the openings for the entrance of air so that the air will be vigorously agitated, and a cooling effect produced by the air currents passing over the bodies of the occupants. The air should enter with high velocities, to secure thorough agitation.

On ships it is necessary that air ducts be made of small diameter, calling for a subdivision of the ventilating system into several units, and, in order to avoid the use of large distributing pipes, it will generally be found advisable to use comparatively small fans, delivering the required volume at pressures of blast of from ½ to 1 ounce to the square inch at the mouth of the fan case, reducing the velocity by enlarging the area of the branch pipes through which the air is delivered to the various compartments.

Naval Constructor Stahl's paper on "An Experimental Test of the Armored Side of U. S. S. 'Iowa'" describes the tests recently made by the Navy Department to ascertain the ability of the backing of the armor plate and the ship frames to withstand the impact of a shot against the plate. The results showed that the framing sustained only most trifling injury, as successive shots were gradually increased in penetrating power, until the armor was actually completely pierced, and even then sustaining local damage only.

For the purpose of this test a target was constructed of the length of one armor plate, consisting of all the framing which exists in the actual ship in rear of such plate, to which was attached in the usual manner the actual armor plate selected for the ballistic test of a group of this armor.

The framing extended the height of the armor plate, and in an inboard direction included the first longitudinal bulkhead within the armor. The total structure was thus 16 ft. long over all, 6½ ft. wide and 7½ ft. high. While such an isolated portion of the ship's side cannot, of course, offer absolutely the same resistance as the corresponding part of the ship itself, thoroughly connected as the latter is with the rest of the hull, yet it was deemed to be a sufficiently fair test to warrant us in accepting the results of the same as representing, with a considerable degree of accuracy, what would happen in the ship under similar circumstances. The framing, on the whole, showed the effectiveness of its design and clearly demonstrated its complete efficiency for its intended purpose.

This test is the most important one that has ever been made, at least in our service, to settle the much discussed question of strength of framing; and it is naturally a great source of satisfaction to all interested in naval affairs to feel that what has been done in the design and construction of such framing in our various ships has been well done, and that no apprehension need be felt on that score.

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PERSONALS.

(Readers are requested to contribute items of interest for publication in this column.)

Mr. R. L. Johnson has been elected City Engineer of Columbus, Ga.

Mr. James R. Shaler has been appointed Manager of the Panama R. R.

Mr. F. M. Drake, Governor-elect of Iowa, is President of the Indiana, Illinois & Iowa R. R.

Mr. Nicholas Monsarrat is President and General Manager of the reorganized Columbus, Sandusky & Hocking Ry. Co.

Hon. Thos. C. Crenshaw has been appointed Railroad Commissioner of Georgia, to succeed Mr. G. G. Jordan.

Mr. John Reymershoffer, Mr. C. H. Moore and Mr. Geo. B. Dermody have been elected Water Commissioners of Houston, Tex.

Mr. A. B. Bonneville, President of the Bonneville Cement Co., of Siegfried, Pa., died at Allentown, Pa., on Nov. 7, at the age of 63.

Mr. John R. Halliday, a water-works contractor, who has installed plants in many parts of the United States, died at Jersey City, on Nov. 5, aged 77 years.

Mr. R. E. Cahill has been appointed to succeed Mr. J. W. Dalbey as Superintendent of the Kansas City Northwestern and the Kansas City & Beatrice Rys.

Mr. Jeremiah Head, the well-known English engineer, and his son, Mr. Archibald P. Head, are making an exhaustive tour of the United States in the interests of British capitalists.

Mr. M. J. McCabe, of whose death in Ireland we have just been informed, was ex-City Engineer of St. Joseph, Mo., and well known in the West as a railroad and government engineer.

Mr. H. W. Hartman has, on account of ill-health, tendered his resignation as President of the Union Water Co., of Beaver Falls, Pa., but has agreed to serve until the election of a successor.

Hon. L. F. Carlile, a partner in the firm of Carlile Bros. & Co., railroad contractors, of Pueblo, Colo., died on Oct. 30, at the age of 50. Mr. Carlile assisted in the construction of a large number of Colorado's railways.

Messrs. Bassell, Olmstead & Bennett, civil engineers, of Los Angeles, Cal., have dissolved partnership. Mr. Burr Bassell, the senior member, will hereafter share offices with Mr. Jas. D. Schuyler, M. Am. Soc. C. E., in the Stimson Building.

Mr. J. R. Williams has resigned his position as Superintendent of the Hastings & Dakota Division of the Chicago, Milwaukee & St. Paul Ry., and will be succeeded by Mr. F. T. Fox, formerly Superintendent of the Iowa & Minnesota Division.

Mr. D. C. Dunlap, M. Am. Soc. C. E., has been appointed Chief Engineer of the Marquette & Iron Range Ry., with headquarters at Marquette, Mich. Mr. Dunlap will also continue to act as chief engineer of the Valley Terminal Ry. of Wisconsin.

Maj. B. F. Jones, who for the past 20 years has been Superintendent of the National Water-Works Co., of Kansas City, Mo., has resigned. Col. R. M. Jones, Superintendent of the Kansas City, Kan., department of the water-works, has also resigned. He will be succeeded by Mr. Geo. B. Wing, formerly Assistant Treasurer of the National Co.

Mr. B. J. Arnold, M. Am. Inst. Elec. E., who designed and built the Intramural Ry. at the Columbian Exposition, recently effected the sale of the Pumpelly-Sorley storage battery patents to the Electric Storage Battery Co., of Philadelphia, at a price amounting in round numbers to $100,000. Mr. Arnold was the chief organizer of the Pumpelly company and its Treasurer

Mr. Alexander E. Schnee, General Sales Agent for the Pohle air-lift pump, with offices at 253 Broadway, New York city, committed suicide by shooting himself, on Nov. 12 in Hoboken. Mr. Schnee was the first to place the Pohle air-lift pump upon the market. Some time ago he was stricken with paralysis of the lower limbs, and his suicide is attributed to ill health. He was about 45 years of age.

Mr. George R. Sherman, of the firm of Witherbee, Sherman & Co., New York city, an owner of extensive iron mines in northern N. Y., died at Port Henry on Nov. 7. Mr. Sherman was President of the Lake Champlain & Moriah Ry. Co., and of the First National Bank of Port Henry, N. Y. To him is due, in a large measure, the development of the mines along the shores of Lake Champlain.

Gen. Thos. L. Casey, late Chief of Engineers, U. S. A.; Mr. Geo. S. Morrison, Pres. Am. Soc. C. E., and Mr. Wm. H. Burr, M. Am. Soc. C. E., have been appointed by the Board of Docks of New York city to serve as a Board of Consulting Engineers, whose duty it shall be to examine and report upon plans for the improvement of the East and North river water-fronts. Work of considerable magnitude is contemplated, especially on the East River and on the North River below 42d St.

Col. William H. Harris, of Cleveland, O., died at Genoa, Italy, on Nov. 6. Colonel Harris was a graduate of West Point in 1861, and immediately entered active service. In 1864 he was given the rank of Lieutenant-Colonel. From the close of the war until 1870, Colonel Harris served as officer in command at several arsenals, and in that year he resigned to enter into business life. He was identified with various manufacturing enterprises, and was at one time Treasurer of the St. Louis, Keokuk & Northwestern Ry. Co. In 1881 he was elected President of the Bucyrus Steam Shovel & Dredge Co.

Mr. Lyman E. Cooley, of Chicago, has been selected by President Cleveland as a member of the commission which is to investigate the feasibility of building deep-water canals between the Atlantic and the Great Lakes. This commission, which comprises, in addition to Mr. Cooley, Mr. J. B. Angell, President of the University of Michigan, and Mr. John E. Russell, ex-Governor of Massachusetts, is appointed under a section of the Civil Service Appropriation bill, passed at the last session of Congress. It provides that the committee shall confer with a similar committee appointed by Great Britain or Canada, and that jointly they shall decide upon some method of pursuing the investigation. The commission is to serve without compensation.

ENGINEERING SOCIETIES.

COMING TECHNICAL MEETINGS.

ENGINEERS' CLUB OF PHILADELPHIA.
Nov. 16. Secy., L. F. Rondinella, 1122 Girard St.
ENGINEERS' CLUB OF MINNEAPOLIS.
Nov. 18. Secy., E. Nexson, Kasota Block.
WESTERN RAILWAY CLUB.
Nov. 19. Secy., W. D. Crosman, Rookery Bldg., Chicago.
COLUMBIAN ENGINEERING SOCIETY.
Nov. 19. Secy., W. F. Hart, University Bldg., 15th and H Sts. N. W., Washington, D. C.
ENGINEERS AND ARCHITECTS' ASSOCIATION OF SOUTHERN CALIFORNIA.
Nov. 20. Secy., F. Van Vleck, Los Angeles, Cal.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
Nov. 20. Secy., J. A. Pilcher, Roanoke, Va.
BOSTON SOCIETY OF CIVIL ENGINEERS.
Nov. 20. Secy., S. E. Tinkham, City Hall.
AMERICAN SOCIETY OF ELECTRICAL ENGINEERS.
Nov. 20. Secy., R. W. Pope, 26 Cortlandt St., New York.
ENGINEERS' CLUB OF ST. LOUIS.
Nov. 20. Secy., W. H. Bryan Turner Block.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
Nov. 20. "The Discharge of the Mississippi River," by Wm. Starling. Secy., C. W. Hunt, 127 E. 23d St., New York.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
Nov. 21. Secy., C. H. McLeod, Montreal.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Nov. 21. Secy., F. A. Charplot, Macon, Ga.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
Nov. 21. Secy., D. Carhart, Carnegie Library, Allegheny.
ENGINEERS' CLUB OF CINCINNATI.
Nov. 21. Secy., J. F. Wilson, Odd Fellows' Temple.
NEW YORK RAILROAD CLUB.
Nov. 21. Secy., John A. Hill, 256 Broadway, N. Y.
INDIANAPOLIS ENGINEERING CLUB.
Nov. 23. Secy., C. C. Brown.
WISCONSIN POLYTECHNIC SOCIETY.
Nov. 20. Secy., W. K. Means, Loan & Trust Bldg., Milwaukee.
CENTRAL RAILWAY CLUB.
Nov. 27 Secy., H. D. Vought, "Courier" Office, Buffalo, N.Y.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Dec. 2. Secy., G. L. Annan, City Engineer's Office.
ENGINEERING SOCIETY OF WESTERN NEW YORK.
Dec. 2. Secy., Geo. R. Sikes, 122 Pearl St., Buffalo, N. Y.
AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
Dec. 3-6. Secy. F. R. Hutton 12 W. 31st St. New York.
WESTERN SOCIETY OF ENGINEERS.
Dec. 4. Secy., Chas. J. Roney, Monadnock Block, Chicago.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
Dec. 6. Secy., O. H. Von Geldern, 819 Market St., San Francisco.
ENGINEERING CLUB OF COLUMBUS, O.
Dec. 7. Secy., David Buell.
ENGINEERS' CLUB OF KANSAS CITY.
Dec. 9. Secy., F. W. Tuttle, Baird Building.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
Dec. 10. Secy., F. A. Colburn, Case Library Building.
DENVER SOCIETY OF CIVIL ENGINEERS.
Dec. 10. Secy., H. Breen, 36 Jacobson Block.
NORTHWEST RAILWAY CLUB.
Dec. 10. Secy., G. A. Seley, 80 Metropolitan Block, St. Paul, Minn.
NORTHWESTERN SOCIETY OF ENGINEERS.
Dec. 10. D. W. McMorris, Burke Bldg., Seattle, Wash.
NEW ENGLAND RAILROAD CLUB.
Dec. 11. Secy., F. M. Curtis, P. O. Box 1576, Boston, Mass.
ENGINEERS AND ARCHITECTS' CLUB OF LOUISVILLE.
Dec. 12. Secy., Jas. K. Zollinger, Norton Building.
ENGINEERING ASSOCIATION OF THE SOUTH.
Dec. 12. Secy., H. D. Ruhm, Nashville, Tenn.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
Dec. 13. Secy., D. W. Meeker, St. Paul, Minn.
MONTANA SOCIETY OF CIVIL ENGINEERS.
Dec. 14. Secy., Forrest J. Smith, Denver Block, Helena.

CENTRAL RAILWAY CLUB.—At the last regular meeting of the year, held in Buffalo, Nov. 8, reports from committees appointed to investigate the following topics were heard and discussed: "The Proper Method of Stenciling the Weight of Freight Cars"; "Steam Heating of Passenger Cars"; "Proper Height

CIVIL ENGINEERS' SOCIETY OF ST. PAUL.—At the meeting on Nov. 4 Mr. Toltz described the rebuilding of the Kettle River bridge approaches, which were destroyed by the Hinckley fire. A record of framing and erecting an average of 100,000 ft. of lumber per day was accomplished on this work. Mr. Hilgard illustrated the method of hydraulic grading practiced on the Northern Pacific R. R. Under favorable circumstances the work of replacing worn-out wooden trestles with embankments is done at a cost of 5 cts. per cu. yd.

C. L. Annan, Secy.

ENGINEERS' CLUB OF PHILADELPHIA.—At the meeting on Nov. 2, Dr. Henry Leffman presented a paper on the "Water Supply of Rome," chiefly taken from the work of Sextus Julius Frontinus, who was water commissioner of Rome 94 to 97 A. D., and dating back in its history to 310 B. C. Mr. Clemens Herschel, who has partially translated Frontinus, finds that at the end of the first century, with an assumed population of 1,000,000, Rome had a daily per capita supply of water of 50 gallons. During the course of four centuries 271 miles of water channels were constructed, of which 230 miles were under ground.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—For the coming annual convention, to be held in New York city Dec. 3 to 6, an interesting programme has been prepared. The papers to be presented to the Society are as follows: "Water Power of Caratunk Falls, Kennebec River, Me.," Samuel McElroy; "Water Power, its Generation and Transmission," Samuel Webber; "Means Adopted for Saving Oil in a Large Oil Refinery," C. E. Emery; "The Reliability of Throttling Calorimeters," James E. Denton; "Some Experiments with the Throttling Calorimeter," A. A. Goubert and E. H. Peabody; "Comparative Tests of Steam Boilers with Different Kinds of Coal," C. E. Emery; "Experiments on the Friction of Screws," Albert Kingsbury; "Tests of a 10-HP. De Laval Steam Turbine," W. F. M. Goss; "Recording Device for Testing Machines," G. W. Bissell; "Effect of Temperature on the Strength of Wrought Iron and Steel," R. C. Carpenter; "Some Data Relating to Forge Shop Design," P. M. Chamberlain; "Experimental Method of Determining the Effective Center of the Light Emitted from a Standard Photometric Burner," D. S. Jacobus; "The Proportions of High-Speed Engines," John H. Barr. Advanced copies of all papers will be sent out to members, and at the meeting they will be read by abstract only. The sessions of the convention will be held mornings and evenings at the Society's house, 12 West 31st St. Afternoons will be left free for members to visit local points of engineering interest.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—At the meeting on Nov. 6 a paper on "A Water System for Placer Mining and a New Method of Construction for Dams" was read by Mr. R. B. Stanton. This paper, of which an abstract was given in our issue of Nov. 7, had been set down for presentation on Nov. 20, but was read at this meeting on account of Mr. Stanton's presence in New York. The paper by Mr. Starling, on "The Discharge of the Mississippi River," was postponed until Nov. 20.

In the discussion, Mr. Whinery said that the loose rock of the dam might slip away, and the brittle asphalt lining then crack, causing serious leaks. The addition of 10 to 15% of pulverized limestone would have increased the strength, and, at the same time, reduced the brittleness. Most asphalts are brittle when pure, but the addition of finely-powdered material makes them stronger and less liable to flow or crack. A rock-fill dam of the type described might be made equally good, and at much less expense, by a facing of earth puddle instead of asphalt concrete, but in Mr. Stanton's case, no material suitable for puddling was available. He had proposed a rubble dam, with hydraulic concrete facing coated with asphalt. California bitumen is a better material than petroleum oil for softening or tempering asphalt. Mr. Cartwright described the use of sheet iron pipe for water supply in California. The pipe has driven joints, and on grades the joint is made pointing upstream (that is, the smaller end of the pipe

is upstream. Then, when water is first turned on, a lot of gravel and earth is dumped into the pipe, and this lodges in and effectually seals any openings at the joints. He did not approve of a gravity rock-fill dam, as suggested by Mr. Stanton, not thinking it stable. He is building a dam 1,300 ft. long and 62 ft. 6 ins. high, which is of rubble masonry, with a tight masonry facing. He intends to build a brick-lined tunnel lengthwise through this dam, the tunnel being enlarged to a chamber containing the valves on the seven 4-ft. discharge pipes. The valves can thus be reached at any stage of water in the reservoir. Electric wires will be carried through the tunnel. Mr. Stanton explained that the asphalt of the lining was made so hard as to be brittle, in order to prevent creeping, which is the usual trouble with such linings, but it is still quite elastic at 32° F. The lining is entirely exposed during the winter (when the weather is intensely cold), all the water being then drawn off. The asphalt resists wear and abrasion in places where plank lining and iron bands are cut out rapidly. In driving the joints, a wooden plug with a collar was placed on the end of the pipe, and struck with a sledge.

CONSTRUCTION NEWS.

CONDENSED LIST OF CONTRACTS PENDING WITH DATE OF OPENING BIDS.

Bids to be opened.	Work.	Place.	See Eng. News.
Nov. 15.	Swing bridge,	Abbeville, La.	Oct. 10
	Advertised, Eng. News, Oct. 10 to 24.		
Nov. 15.	Plans exposition bldgs.,	Nashville, Tenn.	Oct. 17
Nov. 15.	Sewer system,	Champaign, Ill.	Oct. 17
	Advertised, Eng. News, Oct. 17 and 24.		
Nov. 15.	Water-works system,	Honey Brook, Pa.	Oct. 24
Nov. 15.	Bridge superstructure,	Indianapolis, Ind.	Nov. 7
Nov. 15.	Sale of old material at	Indian Head, Md.	Nov. 7
	Advertised, Eng. News, Nov. 7.		
Nov. 15.	Garbage crematory,	Columbus Barracks.	Nov. 7
Nov. 15.	Boilers for electric plant,	Washington.	Nov. 7
Nov. 15.	Asphalt paving,	Brooklyn, N. Y.	Nov. 7
Nov. 16.	Rebuilding bridge,	Boise City, Idaho.	Oct. 31
Nov. 16.	Electric lighting,	Wilkinsburg, Pa.	Oct. 31
Nov. 16.	Water bonds ($1,500),	Calmar, Ia.	Nov. 14
Nov. 16.	Sewer,	Paterson, N. J.	Nov. 14
Nov. 18.	Powder (580,700 lbs.),	Washington, D. C.	Oct. 24
Nov. 18.	County court house,	Galveston, Tex.	Oct. 31
Nov. 18.	Electric lighting,	Rome, N. Y.	Oct. 31
Nov. 18.	Water bonds,	Winton Place, O.	Oct. 31
Nov. 18.	Steam piping, etc.,	Albany, N. Y.	Nov. 14
Nov. 18.	Macadamizing,	Boston, Mass.	Nov. 14
	Advertised, Eng. News, Nov. 14.		
Nov. 18.	Asphalt paving,	Cincinnati, O.	Nov. 14
Nov. 18.	Brick paving,	Albany, N. Y.	Nov. 14
Nov. 18.	Galvanized pipe,	Pittsburg, Pa.	Nov. 14
Nov. 19.	Fixtures, etc.,	Rochester, N. Y.	Nov. 7
Nov. 19.	Swing bridge,	Hamilton, O.	Nov. 7
Nov. 19.	State capitol,	Olympia, Wash.	Sept. 12
	Advertised, Eng. News, Sept. 12 to Oct. 31.		
Nov. 19.	Brick paving,	Terre Haute, Ind.	Nov. 14
Nov. 19.	Stairway,	Jersey City, N. J.	Nov. 14
Nov. 19.	Repaving,	Philadelphia, Pa.	Nov. 14
Nov. 19.	Paving, etc.,	Philadelphia, Pa.	Nov. 14
Nov. 20.	Drainage canal work,	Chicago, Ill.	Sept. 26
	Advertised, Eng. News, Sept. 26 to Nov. 14.		
Nov. 20.	Steel bridge spans (3),	Mobile, Ala.	Oct. 24
	Advertised, Eng. News, Oct. 24 to Nov. 7.		
Nov. 20.	Macadam road (6 miles),	Woodbury, N. J.	Oct. 24
	Advertised, Eng. News, Oct. 24.		
Nov. 20.	Plans water-works, etc.,	Lafayette, Ind.	Nov. 7
Nov. 20.	Electric power mach'y,	Santa Cruz, Cal.	Nov. 14
Nov. 21.	College building,	Austin, Tex.	Oct. 31
Nov. 22.	Brick paving,	Marietta, O.	Oct. 31
Nov. 22.	Main sewers,	Brooklyn, N. Y.	Nov. 14
Nov. 22.	Heating system,	Lawrenceville, Ill.	Nov. 14
Nov. 23.	Macadamizing,	Norwood, O.	Nov. 14
Nov. 23.	Ventilating apparatus,	New York, N. Y.	Nov. 14
Nov. 23.	Water & light bonds,	Le Sueur, Minn.	Nov. 14
Nov. 23.	Light fixtures,	Columbus, Ga.	Nov. 14
Nov. 23.	Light fixtures,	Newark, N. J.	Nov. 14
Nov. 25.	Electric wiring,	Moline, Ill.	Nov. 14
Nov. 26.	Sewers,	Cincinnati, O.	Oct. 31
Nov. 26.	Main sewer,	Evansville, Ind.	Nov. 7
Nov. 26.	Electric wiring,	Brooklyn, N. Y.	Nov. 14
Nov. 27.	Granite pedestal,	Washington, D. C.	Oct. 31
Nov. 27.	Stone paving,	Cleveland, O.	Oct. 31
Nov. 27.	Railway ties,	Moncton, N. B.	Nov. 14
Nov. 27.	Electric light plant,	Topeka, Kan.	Nov. 14
Nov. 28.	Plumbing, etc.,	Chicago, Ill.	Nov. 7
Nov. 28.	Water bonds,	Norwood, Pa.	Nov. 7
Nov. 28.	Sewer system,	Norwood, Pa.	Nov. 7
	Advertised, Eng. News, Nov. 7 and 14.		
Nov. 28.	Water-works system,	Norwood, Pa.	Nov. 7
	Advertised, Eng. News, Nov. 7 and 14.		
Nov. 29.	Street lighting,	Cleveland, O.	Nov. 7
	Advertised, Eng. News, Nov. 7.		
Nov. 29.	Fire engine,	Chetopa, Kan.	Nov. 14
Nov. 29.	School building,	West Hoboken, N. J.	Nov. 14
Nov. 30.	Water-wks. system,	Bay St. Louis, Miss.	Nov. 14
Dec. 2.	Sewers (22 miles),	Mobile, Ala.	Sept. 19
	Advertised, Eng. News, Aug. 29 to Oct. 24.		
Dec. 2.	Brick paving,	Cincinnati, O.	Nov. 7
Dec. 2.	Artesian wells,	Forman, N. Dak.	Nov. 14
Dec. 2.	Artesian well bonds,	Forman, N. Dak.	Nov. 14
Dec. 2.	Paving,	Toledo, O.	Nov. 14
Dec. 2.	Dredging in	Mokelumne River, Cal.	Nov. 14
Dec. 2.	Water bonds ($15,000),	Newberg, Ore.	Nov. 14
Dec. 3.	Water-works system,	Oxford, O.	Nov. 7
	Advertised, Eng. News, Nov. 7 and 14.		
Dec. 3.	Prison work,	Philadelphia, Pa.	Nov. 14
Dec. 4.	Approaches U. S. Bldg.,	Davenport, Ia.	Nov. 7
	Advertised, Eng. News, Nov. 7 and 14.		
Dec. 4.	Water bonds,	Middletown, Ind.	Nov. 7
Dec. 5.	Pump well, etc.,	Evansville, Ind.	Nov. 14
	Advertised, Eng. News, Nov. 14.		
Dec. 5.	Laying cable in	Chile.	Nov. 14
Dec. 5.	Water-works system,	Middletown, Ind.	Nov. 14
Dec. 5.	Intake pipes,	Evansville, Ind.	Nov. 14
	Advertised, Eng. News, Nov. 14.		
Dec. 7.	Iron work for movable dams,	W. Va.	Nov. 14
	Advertised, Eng. News, Nov. 14 to 28.		
Dec. 10.	Garbage disposal,	New York, N. Y.	Oct. 31
Dec. 10.	Wharfwork at	Rimouski, Que.	Nov. 14
Dec. 10.	Dredging in	Christiana River, Del.	Nov. 14
	Advertised, Eng. News, Nov. 14 to Dec. 5.		
Dec. 11.	Pumping engine,	Cleveland, O.	Nov. 14
	Advertised, Eng. News, Nov. 14 and 21.		
Dec. 16.	Water-works system,	Greenville, Miss.	Nov. 14
	Advertised, Eng. News, Nov. 14 to Dec. 5.		
Dec. 17.	Steel rails (4,000 tons),	Ottawa, Ont.	Oct. 24
Dec. 19.	Boiler house, etc.,	Los Angeles, Cal.	Oct. 31
Jan. 7.	Street ry. franchise,	New Orleans, La.	Oct. 17
No date.	Electric railway,	Madison, Ind.	Nov. 14
	Advertised, Eng. News, Nov. 14 and 21.		
"	Sale or lease elec. lt. plant,	Madison.	Nov. 14
	Advertised, Eng. News, Nov. 14 and 21.		

RAILWAYS.

East of Chicago.

AKRON & PITTSBURG.—It is reported that active preparations for building east to Pittsburg are now in progress, and a corps of engineers is already at work inside the limits of Akron, O. This project is said to be an extension of the Northern Ohio Ry., which is operated as a portion of the Lake Erie & Western system. It is expected to commence grading before winter. Pres., A. L. Conger, Akron; Ch. Engr., John H. Sample, Akron, O.

CANTON & EAST LIVERPOOL.—Incorporated in Ohio, Nov. 8, to build a railway from Canton to East Liverpool, passing through Starke, Carroll and Columbiana counties; capital stock, $10,000; incorporators, Jno. N. Taylor, W. L. Smith, Chas. R. Miller, H. Frease, Philip M. Smith.

CHESTERFIELD & MARINE CITY.—A press report states that the grading on the new road from Chesterfield, Mich., to Marine City, has been completed to Algonac, a distance of 26 miles. The grade through that place will not be completed until the rails are laid to the town, but the work will be pushed from there towards the north. About two miles of track is already laid. It is thought that the Grand Trunk Ry. is interested in the project.

DETROIT & MACKINAC.—G. M. Crocker, Auditor, Detroit, Mich., writes us that the 20-mile extension from Emery Junction to Omer has been surveyed and the entire right of way for the same practically secured. About seven miles has been graded, and it is expected to have the rails laid on this portion by Jan. 1. The capital for construction is paid in. Very little contract work is being done. Pres., C. H. Coster, Box 3036, New York; Ch. Engr., A. J. Wenzell, East Tawas, Mich.

EASTERN INDIANA.—Incorporated in Indiana, on Nov. 7, according to press reports, to build a railway from Delphi, Ind., to Dayton, O., 130 miles; capital stock, $50,000.

FLINT & PERE MARQUETTE.—According to a press report from Cleveland, lake shipbuilders have been invited by this company to submit bids for the construction of a steel carferry steamer 350 ft. long, to carry 27 cars. The carferry is probably intended to ply almost exclusively between Manitowoc and Ludington, during the fall, winter and early spring months, and may be utilized to some extent in the transportation to South Chicago of salt destined for points west of the Mississippi.

INDIANA MINERAL.—A press report from Richmond, Ind., states that the survey from Dayton, O., through that city, which had been commonly attributed to the Cleveland, Cincinnati, Chicago & St. Louis Ry., is now known to be in the interests of the recently-incorporated Indiana Mineral. The promoters of the road are said to be E. C. Rice, St. Louis; R. J. Whitney, Alton, Ill.; J. H. Bethune, St. Louis, and S. W. Burkhard, St. Louis.

LAKE ERIE & DETROIT RIVER.—An extension of this road, from Ridgetown, Ont., its present terminus, to St. Thomas, is being surveyed by Owen McKay, Assistant Engineer of the company. Two distinct routes have already been surveyed, and a third is about to be mapped out. Pres., F. H. Walker, Walkerville, Ont.; Ch. Engr., Jos. De Gurse, Windsor, Ont.

LONG LAKE.—The application of this company for permission to build from Axton, N. Y., to the northern end of Long Lake, has been denied by the New York Railroad Commission.

NEW YORK, NEW HAVEN & HARTFORD.—This company is reported to have recently acquired 2½ miles of deep water frontage within four miles of the city hall of Boston. The property is said to comprise 770 acres of land along the banks of the Neponset River, and will be used as a freight terminal.

OLD FORGE.—The owners of the hotel property at Old Forge, N. Y., are contemplating the construction of a spur from the Fulton Chain station on the St. Lawrence & Adirondack Ry. to Old Forge, a distance of two miles. Victor Adams, of Little Falls, is the chief promoter of the project.

TORONTO, HAMILTON & BUFFALO.—The grading on this road, from Welland, Ont., to Toronto, is nearly completed, and track is being laid at the rate of 1½ miles per day. The total length of the route, which passes through Hamilton, is 77½ miles.

Southern.

ALBANY, FLORIDA & NORTHERN.—This road has recently been reorganized under the name of Albany & Northern. At present the length of the line, from Cordele, Ga., to Albany, is 35 miles, but it is expected, as a result of the reorganization, that an extension to Balnbridge, Ga., will soon be undertaken. Eventually the road will be pushed into Alabama, to connect with the Alabama Midland at some point yet to be selected. Pres., Edward Hambleton, Baltimore; Gen. Man., J. S. Crews, Albany, Ga.

FLORENCE & GEORGETOWN.—Press reports state that application has been made for permission to build a road from Florence, S. C., to Georgetown, passing through Claussen, Hymen and Indiantown.

KANAWHA, GLEN JEAN & EASTERN.—Incorporated in West Virginia, Nov. 6, to build a railway from Fayette county to the Virginia boundary line; capital stock, $500,000; incorporators, T. G. McKell, Chillicothe, O.; M. Jackson, R. G. Quarrier, J. F. Brown and E. W. McKnight, all of Charleston, W. Va.

MONONGAH & OHIO RIVER.—J. N. Camden, Pres., states that the contracts for building this line will be let early next spring. The road will give a new Ohio River outlet to the West Virginia Central & Pittsburg and Monongahela River roads, of which ex-Senator Camden is also president. The route extends from a point on the Monongahela River road, near Bingamin Creek, to New Martinsville, on the Ohio River.

POINT PLEASANT, BUCKHANNON & TYGARTS VALLEY.—Hon. Thos. E. Davis, of Grafton, W. Va., writes us concerning this road, which we mentioned last week under Baltimore & Ohio, that capital is in hand and right of way secured. Surveys have been made and contracts will probably be let in the spring. The projected length is 15 miles. Pres., John Bradshaw, Baltimore; Ch. Engr., Garrett Savage, Baltimore.

RICHMOND, NICHOLASVILLE, IRVINE & BEATTYVILLE.—According to a press report from Louisville, Ky., this road will soon be extended from Irvine, its present terminus, to Beattyville, Ky., a distance of 30 miles. The extension has already been surveyed and part of it has been graded. It will pass through Lee and Estill counties in a section rich in minerals and timber. Supt., W. H. Adams, Richmond, Ky.

TOLEDO & OHIO CENTRAL.—A press rumor says a project is on foot to extend this road from Gauley, W. Va., down the Greenbrier River, through the Alleghany and Blue Ridge mountains, and across Virginia to Newport News, giving an outlet to the seaboard. A line has already been surveyed from Gauley in a northeasterly direction to the coal regions of western Pennsylvania, and it is probable this extension will be undertaken first. Pres., Stevenson Burke, Cleveland, O.; Ch. Engr., Clifford Buxton, Toledo, O.

WEST VIRGINIA CENTRAL & PITTSBURG.—This company is replacing its few miles of old 56-lb. rails with the new 70-lb. steel rails used on the rest of the road. Ch. Engr., J. W. Galbreath, Cumberland, Md.

Northwest.

ASHLAND, SISKOWIT & IRON RIVER.—A press report states that articles of incorporation were filed in Wisconsin on Nov. 8 for a logging road under the above name; capital stock, $100,000; incorporators, J. W. Cochran, C. F. Latimer, I. P. Newton, Geo. W. Johnson and W. F. Pleas. Principal office, Ashland, Wis.

CHICAGO, MILWAUKEE & ST. PAUL.—L. B. Beardsley, Div. Supt., writes us that he has no knowledge of the rumored extension of this road from Egan, S. Dak., to Ortonville, Minn.

CHICAGO & NORTHWESTERN.—Press reports state that this company is building a six-mile extension of the spur line from Aniwa to Mattoon, Wis. The Mattoon Mfg. Co., which holds a lease of this branch railway for a term of years, will clear a right of way, grade the roadbed and furnish the ties, and the Chicago & Northwestern will lay the steel rails. Trains are expected to run over the new line before Christmas.

DULUTH, PIERRE & BLACK HILLS.—Citizens of Pierre, S. Dak., and of Aberdeen are endeavoring to bring about the construction of a road between those two towns, and on to St. Paul and Minneapolis. As yet no indications have been given that the necessary capital will be forthcoming immediately. It is the intention, of course, to enlist the aid of St. Paul and Minneapolis on the strength of the rich mineral resources which would thus be given an outlet.

INDIANA, ILLINOIS & IOWA.—T. P. Shouts, Gen. Man., 919 The Rookery, Chicago, writes concerning the two-mile extension of this road into Streator, Ill., that work will probably be completed by Dec. 15. The company is doing all work except grading.

MERRILL, ANTIGO & EASTERN.—Press reports state this company, which proposes building a line from Prentice, Wis., to some point on Lake Michigan, is ready to let the contracts for clearing the right of way and building the grade eastward to the Wolf River.

Southwest.

CALVERT & BRAZOS RIVER.—Incorporated in Texas to build a railway in Robertson county, southwest from Calvert, to the junction of the International & Great Northern and the Hearne & Brazos Valley Rys.; capital stock, $300,000; incorporators, S. T. Fuller, S. H. Parish, John T. Garrett, M. L. Collatt, C. R. McCrary, William McIntosh, James L. Auerdale, G. K. Proctor, Scott Field, E. S. Peters, J. P. Casimer, W. S. Allen, J. T. Garrett, James Connaughton, all of Calvert, Tex.

GALVESTON, LA PORTE & HOUSTON.—According to a press report, this railway is nearing completion, and it is expected that Dec. 1 will see trains in operation. This is the third road to be built between Galveston and Houston, Tex. It is thought that the new line will be used by the Missouri, Kansas & Texas, and perhaps also by the Houston, East & West Texas.

HAMBURG & SUNNYSIDE.—A press report from Hamburg, Ark., states that a railway may be built from that place to Sunnyside, about 50 miles distant on the Mississippi River. Austin Corbin, of New York, is extensively interested in property at the latter place, and is the promoter of the project.

KANSAS CITY, PITTSBURG & GULF.—Work on the southern end of the route, from Beaumont, Tex., to Port Arthur, on Sabine Lake, has been commenced, surveyors having started from the Beaumont end.

MUSKOGEE, OKLAHOMA & WESTERN.—W. H. Herbert, Gen. Man., writes us concerning this proposed road, that it is projected to extend from Muskogee, Ind. T., to Woodward, Okla., through the towns of Cleveland, Pawnee, Perry and Enid. The intention is to extend further west to Albuquerque, N. Mex., or other desirable point, which will give an outlet to the rich cattle-raising land in northern Texas. The middle division of the road, from Enid to the mouth of the Cinnamon River, is surveyed, the profile completed and right of way secured. The projected route will be 200 miles shorter than that of any line in existence or proposed. Pres., G. W. Sutton, Cleveland, Okla.; Ch. Engr., E. W. Hill, Cleveland.

ST. LOUIS, SILOAM & SOUTHERN.—A consolidation has been effected by the two companies chartered under the above name, one in Missouri, the second in Arkansas. It is proposed to construct a railway from St. Louis to Fort Smith, Ark., about 300 miles in length. The work of construction is now going on at the St. Louis end. The route in Arkansas is through the counties of Baxter, Marion, Boone, Newton, Madison, Franklin, Crawford and Sebastian. The capital stock of the consolidated company is $8,000,000. Pres., Hector D. Mackay, St. Louis; Sec., T. G. Portis, St. Louis; Treas., Wm. J. Kreybill, St. Louis.

Rocky Mt. and Pacific.

COLORADO SPRINGS & CRIPPLE CREEK.—A railway between these two points is projected to run through Bear Creek Canyon. As yet the financial supporters of the project have not made themselves known, and no authentic information concerning the proposed line is obtainable. It is said, however, that a survey has been made, and that the route thus laid out is 28 miles in length, with a maximum grade of 3%.

INTERMOUNTAIN.—According to press reports, a project is on foot to build a road from Lafayette, Colo., a point on the Burlington, to Boulder and into the mining districts beyond. It is said that a narrow gage road is contemplated, although it is probable that standard gage will be used as far as Boulder.

NATIONAL CITY & OTAY.—H. N. Savage, Ch. Engr., National City, Cal., informs us that the earthwork contract for the relocated portion of this road, which was washed out in the flood of last January, has been let to J. C. Long. The bids received will be found in another column under Contract Prices. The work now being undertaken includes a one-mile extension to Tia Juana, in addition to the two miles of reconstruction. It is expected that trains will be running by Jan. 1.

WEST SHORE.—Surveys are being made for a coast line from San Francisco to Santa Cruz, and it is reported that the work of construction will begin within two months. The proposed location of the road will involve much heavy work, several tunnels and frequent trestle work being required. Pres., C. M. Sanger, Milwaukee, Wis.

Foreign.

RIO GRANDE, SIERRA MADRE & PACIFIC.—J. F. Crosby, of El Paso, Tex., writes us concerning this proposed Mexican railway, that the projected route is from Juarez to Guerrero through Acenslon, San Pedro, Corralitos, Casas Grandes, San Buenaventura, El Valle and San Miguel, a distance of 350 miles. Concessions have been secured from the government, including a subsidy of $10,000 per mile. Right of way is assured. No contracts have been let.

STREET AND ELECTRIC RAILWAYS.

BANGOR, ME.—The Bangor & Winterport Electric Ry. Co. has applied for a franchise. Gen. Henry L. Mitchell, Smith Block, Bangor, is interested.

SKOWHEGAN, ME.—Surveys have been completed for an electric railway between Skowhegan and Madison.

BENNINGTON, VT.—Preliminary surveys have been made for the electric railway projected for several years from this city to North Bennington, and thence to Hoosick Falls, N. Y. It is reported that the line will be built in the spring. The Bennington & Rutland branch from North Bennington to this city will soon be operated by electricity, as noted last week.

BURLINGTON, VT.—The Winooski & Burlington R. R. Co. has been granted a franchise for extensions of its electric railway on several streets, and the materials have already been purchased. Several new cars will also be bought.

AMHERST, MASS.—The construction of an electric road to connect this city with Northampton and North Amherst is being discussed. Dwight W. Palmer, L. D. Hills, Pres. First National Bank; E. P. Crowell, Dean Amherst College, of Amherst, and W. D. Cowles, of North Amherst, are interested.

RANDOLPH, MASS.—The extension of the Quincy & Boston Electric Ry. from South Braintree to Randolph and Holbrook is being considered. Pres., John R. Graham; Supt., B. J. Weeks, of Quincy.

SHELBURNE FALLS, MASS.—It is stated that construction companies will soon be asked to make estimates for building an electric road, seven miles long, between this place and Colrain City, estimated to cost $75,000. Engr., H. L. Pierce, Greenfield & Turner's Falls Ry. Co.; C. A. Marcy, of Colrain City; Herbert Newell, of Shelburne, and Albert J. Annstein, of Buckland, are on the committee.

WAKEFIELD, MASS.—The Peabody, Lynnfield & Wakefield Electric St. Ry. Co. has been organized to build a line about 10 miles long; capital stock, $50,000; B. W. Russell and Thos. H. Johnson, of Salem, Mass.; J. M. Danforth, of Lynnfield, and E. P. Shaw, of Newburyport, Mass., are interested.

MILFORD, CONN.—The Milford Electric Ry. Co. is to be organized immediately to build a line eight miles long, from Naugatuck Junction southward to the shore, thence to Milford, with an extension to Woodmont and Woodmont station. Gen. G. H. Ford, of New Haven; Charles A. Tomlinson, William B. Stoddard, George M. Gunn, ex-Representative Tibbals and Charles W. Beardsley are interested. Although the new company has a capital stock of $100,000, the organization will start, in all probability, with stock amounting to about half this sum.

CATSKILL, N. Y.—The Catskill, Cairo & Windham St. R. R. Co. was incorporated Nov. 8 to construct a line, about 10 miles in length, in Greene county, from Long Dock, at Catskill Landing, to Main St., in Catskill village, and to the Susquehanna turnpike, in Cairo; capital stock, $100,000; directors, Louis E. Robert, Michael W. Conway, William C. Wood, Daniel H. Gilligan, John L. Heins and Jacob Faber, of Brooklyn; Daniel Sharp, of Catskill, and S. Mattison, of Newark, N. J.

COHOES, N. Y.—The Cohoes City Electric R. R. Co. is about to begin an extension of about one mile toward West Troy. The contracts have been let for the above, and work will be begun immediately. Engrs., DeWitt C. Smith and W. Greenbalch; Engr. in Charge, Lewis B. Sebring, Schenectady.

NEW YORK, N. Y.—The Metropolitan Traction Co. has secured control of the Eighth Ave. R. R. It is stated that the company will soon begin to make a number of improvements to the Eighth Ave. line.

NEW YORK, N. Y.—The North End St. Ry. Co. has been incorporated to construct a street railway, 13 miles in length from Manhattan Ave. and 116th St. to Kingsbridge Road and the northerly city line; capital stock, $5,000,000; directors, Edward K. Lynch, Wm. D. Davids and Thomas E. Laughlin, of Brooklyn; Daniel H. Shea, Chas. B. Sisson, Thos. J. Regan, Frank F. Ogston and Wm. C. Shaller, of New York.

NIAGARA FALLS, N. Y.—James S. Simmons, of Niagara Falls, N. Y., writes us that the capital for the construction of the Niagara Falls Electric St. Ry., five miles long, has been secured, and work will be begun as soon as the franchise has been granted. The company was incorporated with a capital stock of $50,000, as stated in our issue of Oct. 10. Pres., A. C. Denniston, Bullitt Bldg., Philadelphia, Pa.

PHILADELPHIA, PA.—The board of district surveys is considering plans for extending the Delaware & Schuylkill Electric Ry.

SCRANTON, PA.—J. M. Burke, Pres., Scranton, writes us that no work will be done on the Dunmore St. Ry. before next spring or summer. Ch. Engr., Robert Fox, Scranton.

LOUISVILLE, KY.—Rowland Cox, Taylorsville, Ky., is making surveys for the Louisville, Mount Washington & Fairfield Electric Ry., 32 miles long. The company is ready to let contracts, as noted in our issue of Oct. 24. J. C. Wright, of Louisville, and F. M. Lilly, of Fairfield, Ky., are interested.

KNOXVILLE, TENN.—W. G. McAdoo and Chas. J. Yerkes, of Knoxville, are making arrangements to begin the construction of the Citizens' Electric St. Ry.

LORAIN, O.—It is reported that another company will be formed to build an electric road from Cleveland to this city. The new company is composed of B. Mahler, Sidney Short, of the electrical works; E. G. Tillotson, Treas. Cleveland Trust Co.; Ed Moore, Congressman C. B. Beach, W. H. Lawrence and F. Wayland Brown. The capital stock of the new company is $500,000.

LORAIN, O.—The East Lorain St. Ry. Co. is about to extend its electric road, now being built, to Cleveland, 24 miles, at an estimated cost of $200,000. Pres., Wm. McReynolds; Vice-Pres., J. W. McReynolds; Treas., W. J. Gawn. Mark Hanna, of Chicago, Ill., is interested. Capital stock, $10,000, but later it is to be increased to $500,000.

NEWARK, O.—The Newark Consolidated Electric Ry. Co. has been incorporated, with a capital stock of $250,000, by Reinhardt Scheidler, J. A. Flory, F. A. Crane, Herbert Atherton and others, of Newark, O.

MADISON, IND.—The city wishes to sell or lease its electric light plant to a company that will construct an electric railway in the city, as stated in our advertising columns. Ellison D. McGuire, Mayor.

NEW ALBANY, IND.—The Commercial Club, of this city, is reported to have about completed arrangements for the construction of the proposed electric road between New Albany and Evansville, Ind. D. W. Soliday is interested.

BENTON HARBOR, MICH.—An electric road four miles long is to be built to Eastman Springs, and, probably, later on to St. Joseph. John S. Clark, Benton Harbor, is interested.

FENTON, MICH.—John E. Nolan, of Saginaw, has been granted a franchise in this place for an electric road 16 miles long from Detroit.

MONROE, MICH.—L. E. Walkins, Ch. Engr., 36 Court St., Boston, Mass., writes us that Starkey & Elles, 6 Wall St., New York, N. Y., have been awarded the contract for constructing the Monroe St. Ry., 13 miles long. The road will be built only in Monroe this year, but next spring it will be extended to Dundee. The entire route has been surveyed and right of way secured. The full amount of the capital stock has been subscribed. This line will be a branch of the Toledo & Detroit Fast Freight Electric Ry., to be built next year. Pres., W. H. Cowles, Monroe.

CHARLESTON, ILL.—It is stated that A. M. Searles, of Chicago, is interested in a projected electric road to Mattoon, estimated to cost about $75,000.

LA CROSSE, WIS.—It is stated that plans have been completed for the proposed electric road, 70 miles long, from La Crosse to Neillsville, by way of Black River Falls and Merrillan. Engr., Fred H. Pickles, Winona, Minn.

OSHKOSH, WIS.—In addition to the contract awarded to G. F. Melton Co., of New York, N. Y., for the construction of 41 miles of the Central Wisconsin Electric Ry. in this city and vicinity, as noted in our issue of last week, it is reported that the following were awarded: Arbuckle, Ryan & Co., Toledo, O., construction of steam plants, etc., $60,000; Walker Mfg. Co., of Cleveland, electrical apparatus, etc., $52,000; St. Louis Car Co., St. Louis, Mo., cars, $43,000. The Central Construction Co. is the name of the company that has contracted with the railway company to build the road; capital stock, $300,000. The directors are: B. R. Barr, Cleveland; George J. Kobrisch, St. Louis; G. F. Mellen, New York, N. Y.; J. M. Arbuckle, George H. Ketcham, and J. K. Tillotson, Toledo, and E. R. Stittins, Chicago. The Central Wisconsin Electric Ry. Co. has a capital stock of $1,000,000. The directors are Frank M. Ohl, C. T. Lewis, and Clarence Brown, of Toledo, and E. E. Stevens, of Oshkosh. The contracts call for the completion of the entire system by June 15, 1896. Work will be commenced next week and pushed as rapidly as the weather will permit.

WAUKESHA, WIS.—The Milwaukee & Wauwatosa Motor Ry. Co. is preparing to build an electric road through this place, the contract for which has been awarded to the Thayer Electric Co., of Milwaukee, at $185,000. Other extensions are also proposed, making a total cost of about $350,000. Col. P. McWhorter, J. J. Constantine and E. G. Dousman, of Waukesha, and J. W. Bingham, A. B. Meyers and James Petley, of Milwaukee, are interested.

MANKATO, MINN.—S. R. Snow, Mankato, writes us that an ordinance has passed its first reading granting a franchise for an electric railway and electric light plant.

ST. PAUL, MINN.—It is proposed to build a second electric railway between this city and Minneapolis, at a cost of about $100,000, by the Twin City Rapid Transit Co. Pres., Thos. Lowry, Minneapolis.

CAPE GIRARDEAU, MO.—The Citizens' St. Ry. Co. has been incorporated, with a capital stock of $20,000, by L. S. Joseph, W. S. Albert and John L. Miller.

KANSAS CITY, MO.—It is stated that the Missouri, Kansas & Texas Trust Co. is endeavoring to purchase the franchise of an electric railway company incorporated about 10 years ago. A part of the proposed electric road was built at the time of incorporation on Fifth St. to Lydia. Willard E. Winner, Wm. Chrisman, W. W. Kendall and Theo. S. Case are interested. ——Willard E. Winner, Pres. Westport & Waldo Park Electric Ry. Co., has petitioned the citizens of Lee's Summit for permission to extend the road to that place, 8½ miles. Engr., W. H. Dunn, Kansas City, Mo.

ST. JOSEPH, MO.—The St. Joseph Traction & Lighting Co. has been reorganized, and will hereafter be known as the St. Joseph Ry., Light, Heat & Power Co.; capital stock, $3,500,000, $1,500,000 of which is preferred stock. The latter stock is taken by William M. Harriman and Camille Weidenfeld, of New York, N. Y. The common stock is taken by George D. Patten, of Plainfield, N. J.; Alfred Deckers, South Orange, N. J.; R. A. Brown and W. T. Van Brunt, of St. Joseph.

WEBB CITY, MO.—J. J. Funk, Mayor, writes us that the Jasper County Electric Ry. Co., of Carthage, Mo., has not secured a franchise in this city, as it did not bid for it when offered for sale on Nov. 6. Pres., W. W. Calhoon; Ch. Engr., F. H. Fitch, Carthage.

WEST PLAINS, MO.—Surveys are being made for an electric railway from Hunter to White Plains, Mammouth Springs, Harrison and Fort Smith. W. H. Evans and A. H. Livingstone, West Plains; Newman Erb, of New York, N. Y., and Louis Houck, of Cape Girardeau, Mo., are interested.

BOULDER, COLO.—The Western Electric Transit & Power Co. has been incorporated by Edwin B. Goodwin, H. J. Danford, W. K. Mehollin, Bernard Mallon, Frank Kline, Oliver I. Cheney, John Leahy and A. J. Macky. Capital stock, $100,000.

HALF MOON BAY, CAL.—A company has made surveys for an electric road from Santa Cruz, by way of this place, to San Francisco. Pres., W. H. H. Hart.

QUEBEC, QUE.—Press reports state as follows: Canadian capitalists are interesting themselves in the project of an electric railway in Buenos Ayres, Argentine Republic. The city has 750,000 inhabitants, and there are only two streets in which the electric company has not the right to construct tracks. The matter has been brought to the attention of capitalists by J. Arthur Maguire, Consul-General here for the Argentine Republic, and several men of wealth are joining the promoters of the Buenos Ayres railway.

ELECTRIC LIGHT AND POWER.

BELFAST, ME.—The Petit Manan Land & Improvement Co., Opera House Block, Belfast, it is reported, proposes to put an electric light plant in Petit Manan, a suburb of this city. This suburb, which has recently been laid out, will have 16 miles of streets.

CONTOOCOOK, N. H.—The construction of an electric light plant is being considered, according to reports.

BLACKSTONE, MASS.—A franchise has been granted for an electric light plant. Robt. E. Tabor, F. N. Thayer and Jeremiah Gatchell are interested.

BOSTON, MASS.—A public hearing will be held in the city hall Nov. 14 in regard to a municipal electric light plant for this city. Chas. H. Bryant, Chn. Com.

TISBURY, MASS.—The selectmen have granted R. W. Crocker, North Tisbury, a franchise for an electric light plant.

PLAINVILLE, CONN.—A committee has been appointed to consider the question of electric lighting. Hiram Carter, Chn.; Wm. W. Bullen, Town Clk.

BROOKLYN, N. Y.—Bids are asked until Nov. 26 for wiring the municipal building for electric lights. A. T. White, Comr. Cy. Wks.

GOWANDA, N. Y.—An election has been held to vote on the question of a municipal electric light plant.

NEW YORK, N. Y.—Henry O. Havemeyer is to build a power house at 115 and 117 Crosby St., extending through to 84 and 86 Marion St., which will furnish power for the office building which he is erecting on the site of the old Metropolitan Hotel on Broadway.

NEWARK, N. J.—Bids are asked until Nov. 23 for gas and electric light fixtures for the custom house in this city. W. E. Curtis, Acting Secy., Treasury Dept., Washington, D. C.

AVOCA, PA.—It is stated that this place has voted for electric lights.

CATAWISSA, PA.—It is reported that, by a vote of 307 to 59, the citizens of the borough voted in favor of a municipal electric light plant.

PITTSBURG, PA.—Bids are asked until Nov. 18 for 2,000 ft. of 2-in. galvanized iron pipe for the use of the bureau of electricity. J. O. Brown, Dir. Dept. Pub. Safety.

WASHINGTON, D. C.—Local papers state that control of property located on Water and 33d Sts., Georgetown, known as the Dent Foundry & Iron Works has been acquired by Crosby & Lieb, who own the controlling interest in the Georgetown & Tenleytown Electric R. R. They also purchased some time ago the plant of the Potomac Heat & Power Co., which was located on the Virginia side of the river, and now hold the charter of that company. It is their intention to establish a plant on the site just purchased for furnishing electric power. The property acquired contained about 90,000 sq. ft. of ground. The buildings now there will be either torn down or remodeled for the purposes of the new owners. It is expected that soon the power house of the Georgetown & Tenleytown R. R. will be located at this point, and the new company will furnish power not only to operate the railway, but also to give electric light to that section, especially the suburbs. The company has already made arrangements to furnish electric light in Tenleytown, and the poles for carrying the wires have already been put up.

MADISON, N. C.—The Mayo-Dan Cotton Mill, at this place, now approaching completion, will include an electric light plant as a part of its equipment.

COLUMBUS, GA.—Bids are asked until Nov. 23 for gas and electric light fixtures for the post office building in this city. W. E. Curtis, Acting Secy., Treasury Dept., Washington, D. C.

SHEFFIELD, ALA.—It is reported that the construction of an electric light plant and water-works is being considered.

OWENSBORO, KY.—It is stated that an election will be held to vote on the question of issuing $25,000 in bonds for an electric light plant.

ASHTABULA, O.—This city, on Nov. 5, voted to issue bonds for an electric light plant.

MADISON, IND.—The city wishes to sell or lease its municipal electric light plant, as noted in our advertising columns. Ellison D. McGuire, Mayor.

BENTON HARBOR, MICH.—The committee has rec-

ommended to the council the construction of an electric light plant.

BUCHANAN, MICH.—It is proposed by the Buchanan Power & Electric Co., through the Michigan Trust Co., receiver, to sell to the village the water power, electric plant and all the property owned by it in the village, for $75,000. Peter English is interested.

ONTONAGON, MICH.—It is stated that the citizens have voted to issue $12,000 in bonds for an electric light plant.

CHICAGO, ILL.—We have received the following information concerning the electric light plant proposed by the west side park commissioners: The plant will have an ultimate capacity of 1,000 arc lights, which will be used for lighting the West Chicago parks and boulevards. The wires will be under ground, and there will be 60 miles of lead-covered cable required. This cable will be laid in pump logs, work on which will be begun this fall. The power house will be erected in Garfield Park, near the tracks of the Chicago & Northwestern Ry. There will be two 250-HP. boilers provided with automatic stokers and suitable conveyors and elevators for handling the coal and ashes. There will be two 500-HP. cross-compound Corliss engines, but only one of these engines will be erected at present. The power from the engine will be conveyed to a counter-shaft by a rope drive. This counter-shaft will be built in two sections, each section being 30 ft. long. There will be six 125-arc light dynamos and 625 double-circuit arc lights. The plant is designed for an ultimate capacity of double that for which it is being built. Especial attention is being paid in the design and construction of the plant to secure economy, and no expense is being spared in this direction. Engr., Force Bain, Monadnock Bldg.

MANITO, ILL.—Joseph Seely, Geo. E. Gramm and Geo. Knollhoff have been appointed a committee to consider the advisability of constructing an electric light plant.

MOLINE, ILL.—Bids are asked by the board of directors until Nov. 25 for electric wiring, gas fitting, etc., for the city hospital.

SUPERIOR, WIS.—F. A. Ross, of the Wisconsin Power Co., writes us that the company will not do any work this year. The company was incorporated last month with a capital stock of $100,000 by W. D. Dwyer and S. T. Novell.

DAVENPORT, IA.—It is reported that the board of public works will advertise for bids for lighting the city by electricity for five years, commencing June, 1896. N. C. Martin, Clk.

LE SUEUR, MINN.—Bids are asked until Nov. 23 for the purchase of $20,000 of 5% electric light and water-works bonds. C. L. Martin, Cy. Clk.

PRESTON, MINN.—It is stated that this city has voted to issue $18,000 in bonds, $4,500 of which is for an electric light plant, and the remainder for water-works. W. R. Todd, Mayor.

SAUK RAPIDS, MINN.—It is reported that the citizens of this place will soon vote on the question of issuing $25,000 in bonds for improving the water power, etc.

TOPEKA, KAN.—Bids are asked until Nov. 27 for one 75-HP. engine, two arc dynamos of 40 lights each, 60 arc lights, etc., for an electric light plant for this city. S. S. McFadden, Cy. Clk.

AUSTIN, TEX.—It is reported that the Goulds Mfg. Co., Seneca Falls, N. Y., has been awarded the contract at $8,655 for power pumps for utilizing the water which flows from a spring under the power house.

SEATTLE, WASH.—It is stated that the board of public works has received the following proposition from A. L. Hawley, F. H. Osgood and J. T. Robinson to build an electric light plant, and to sell, with the exception of steam plant, dynamos and station equipment, to the city for $66,000, in 36 monthly payments, the city to grant a franchise to furnish heat, power and light on the terms of the present franchises; for additional lighting during the operation of the contract the price is to be for arc lights, $7.25 per month; 15 c. p. incandescent, $1 per month. The other bids were as follows: Union Electric Co., arc lights, $9.90 per month; incandescent lights, 15 c. p., $1.80; 30 c. p., $2.80; Third St. & Suburban R. R. Co., arc lights, $9.95; incandescent, 15 c. p., $1.85; 30 c. p., $2.95.

BERKELEY, CAL.—The board of trustees has voted to advertise for bids for furnishing 125 incandescent lights.

SANTA CRUZ, CAL.—Bids are asked until Nov. 20 for the electrical machinery for the water power plant noted in our issue of Oct. 31. F. W. Swanton, the promoter, writes us that the work will cost about $65,000. The surveys have been completed, and Roebling & Sons have been awarded the contract for 64 miles of 7 B. S. gage 4-strand wire. About 600 HP. will be delivered a distance of 16 miles. There will be 10,800 ft. of flume, 1,900 ft. of 14 and 16-in. pipe and 2 Pelton water wheels.

NEEPAWA, MAN.—It is reported that a company with a capital stock of $20,000 has been organized to build an electric light plant for this place.

NEW COMPANIES.—Reed Electric Co., Philadelphia, Pa.; $500,000; Amos W. Bacon, C. J. Reed, Carl Herling, Philadelphia, and Marcellus T. Morrill, Camden, N. J.

Williams Electric Light Co., Williams, Ariz.; $10,000; George E. Nolan, Los Angeles, Cal.; S. C. Wyncoop, Phoenix, Ariz.

Camden Water, Light & Power Co., St. Louis, Mo.; $50,000; F. W. Paramore, H. F. Mueller, E. E. Paramore, Charles Brown.

Gouverneur Electric Light & Power Co., Gouverneur, N. Y.; $500; Carrie McCrae, John P. Killmer, J. R. McIntyre, Gouverneur.

Great Western Light & Heat Co., Des Moines, Ia.; $250,000; Pres., G. W. Benedict, Des Moines; Secy., E. P. Thompson, Oakland, Cal.

Philadelphia Electric Equipment Co., Philadelphia, Pa.; $50,000; Matthew A. Retew, James R. Retew, Edward T. Watts, A. F. Laidlow, all of Philadelphia; John Maxwell, New York.

Hafemeister Electric & Machine Co., Cleveland, O.; to manufacture machinery and electrical goods; $5,000; F. C. Hafemeister, G. C. Spaller, Henry F. Stolte, Wm. Hafemeister, W. F. Cowley.

Washington Light, Heat & Power Co., Washington, N. J.; $24,000, with $1,000 paid in; John Karr, Hackettstown, N. J.; Wm. A. Stryker, Frank P. McKinstry, John W. Fitts, Washington, N. J.

Premier Electrical Co., Springfield, N. J.; $50,000, with $1,000 paid in; to manufacture electrical apparatus, etc.; Louis A. Jackson, Daniel Jackson, New York, N. Y.; Leon Abbett, Hoboken, N. J.

Scott & Janney Electric & Mfg. Co., Philadelphia, Pa.; $5,000,000, with $500 paid in; to manufacture electrical apparatus; D. W. Lane, M. D.; Geo. W. Edmunds, Andy Brann, Chas. Watson, Geo. H. Hill State, all of Philadelphia.

Beatrice Electric Co., Beatrice, Neb.; consolidation of the Beatrice Light & Power Co. and the Beatrice Rapid Transit Co.; $100,000; John A. Horbach, Paul W. Horbach, Victor G. Lantry, Omaha; J. E. Smith, A. S. Maxwell, Beatrice.

International Electric Co., New York, N. Y.; $2,000,000, with $10,000 paid in; to manufacture dynamos, motors, electric railway equipment, etc.; John H. Hawkins, Steubenville, O.; Wm. J. Dixon, Toronto, Ont.; John M. Murphy, Danbury, Conn.

St. Joseph Railway, Light, Heat & Power Co., St. Joseph, Mo.; reorganization of the St. Joseph Traction & Lighting Co.; $3,500,000, of this $1,500,000 is preferred stock; Wm. M. Harriman, Camille Weidenfeld, New York, N. Y.; W. T. Van Brunt, St. Joseph.

Benning Current Motor Co., Boone, Ia.; $50,000; to generate electricity; Pres., A. B. Stedman; Vice-Pres., A. L. Bradly; Secy., A. B. Millerd; Treas., E. A. Turner; Supt. Construction, Wm. J. Benning; directors, O. M. Brockett, W. A. Kimble, Clinton Crouch.

Washoe Irrigation & Power Co., Washoe, Idaho; $20,000, with full amount paid in; to construct a canal in Canyon county, taking water from the Payette River, for irrigating lands on the Washoe bottom and for furnishing power; Stillman Mack, W. W. Paine, Jacob Widdle, J. L. Henshaw, Washoe; James T. Clements, Ontario, Ore.

Pleasant Beach Electrical Park Association, Syracuse, N. Y.; $125,000; the following board of directors was elected: John W. Truesdell, I. C. Reed, Louis House, Frank T. Miller, A. E. Aldridge, all of Syracuse; A. T. Hotaling, of Baldwinsville, and I. M. Price, of Philadelphia. The list of officers elected is as follows: Pres., A. T. Hotaling, Baldwinsville, N. Y.; Vice-Pres., John W. Truesdell, Syracuse; Treas., Frank T. Miller, Syracuse; Secy., I. M. Price, Philadelphia, Pa.; Man., A. E. Aldridge, Syracuse.

BRIDGES.

NEW HAVEN, CONN.—Cassius W. Kelly, Cy. Engr., has about completed plans for a new $50,000 drawbridge over the Quinnipiac River, at Grand Ave.—Ex-City Engineer Hill, of this city, has reported that the Derby Ave. bridge is unsafe, and that a new bridge, to cost about $16,000, should soon be constructed.

NEW YORK, N. Y.—Louis F. Haffen, Comr. Dept. St. Improvements in the 23d and 24th wards, has prepared plans for an additional northerly approach to the new Third Ave. bridge. It is proposed to take by condemnation proceedings enough property to make a roadway connecting the bridge with the Southern Boulevard. Such an approach will save a haul of four blocks for traffic to and from the Boulevard.—The construction of a viaduct over the new Jerome Park reservoir, at Jerome Ave., is being considered by the board of street opening and improvement.

FLEMINGTON, N. J.—The freeholders of Hunterdon and Warren counties have decided to construct a 90-ft. iron bridge at Hughesville, according to reports.

NEWARK, N. J.—The citizens of Hudson and Essex counties voted Nov. 5 against the construction of a $110,000 bridge over the Passaic River, from Fourth St., Harrison, to Madison St., Newark. As the law stands, the people of Harrison and Kearny can yet have their bridge across a mile of meadow land by agreeing to pay half the expense of its erection themselves. John Boyd, Clk. Bd. Freeholders, Jersey City.

MIDDLETOWN, PA.—The following bids were received Nov. 7 by the commissioners of Dauphin county, at Harrisburg, for renewals to the aqueduct bridge at this place:

•Nelson & Buchanan, Chambersburg, Pa.	$4,980
King Bridge Co., Cleveland, O.	5,280
Massillon Bridge Co., Massillon, O.	5,143
Wrought Iron Bridge Co., Canton, O.	5,360

•Awarded contract.

PITTSBURG, PA.—It is stated that the Homestead & Highland Ry. Co. will probably build a bridge over the Monongahela River, near Walnut St.

WILKES BARRE, PA.—The commissioners of Luzerne county have been recommended to construct 30 bridges, to cost from $150 to $1,500 each.—The grand jury has been petitioned to construct a $13,000 bridge at Kingston. J. W. Hallenback and H. H. Welles, Jr., are interested.

BENWOOD, W. VA.—It is reported that Trimble & Miller, of Pittsburg, Pa., have been engaged to prepare plans for the Bellaire and Benwood bridge, noted in our issue of Oct. 31. Geo. W. Yost, of Bellaire, O., is interested.

CHARLOTTE, N. C.—The board of commissioners of Mecklenburg county are considering the question of building an iron bridge across the Catawba River in this county, near Charlotte, to cost about $10,000. Address Chairman Board County Commissioners, Mecklenburg county, Charlotte.

ATLANTA, GA.—The bridge committee of the council is considering the question of constructing a bridge at Jones Ave., to cost $15,000.

NEW ORLEANS, LA.—Chas. R. Kennedy, Cy. Comptroller, received the following bids Nov. 4 for constructing a new iron bridge at Carrollton Ave.:

John McNally, New Orleans	$18,400
H. J. Bruning, New Orleans	21,900
Missouri Valley B'ge & Iron Wks., Leavenworth	21,500
Toledo Bridge Co., Toledo, O.	21,600
Gillett-Herzog Mfg. Co., Minneapolis, Minn.	21,000

ASHLAND, KY.—Samuel Bigstaff, Ashland, writes us that the Ashland & Ohio Bridge Co. proposes to build a railway and general traffic bridge between Ashland, Ky., and Ironton, O. Surveys, soundings and borings have been made. A syndicate is now being formed to build the structure.

CLEVELAND, O.—Plans are being prepared for the bridge over Walworth Run, at Rhodes Ave., which will be of the plate girder pattern, about 500 ft. long, and made in five or six spans. From Willett St. to the Nickel Plate tracks it is intended to make an earth embankment. The bridge will be from 60 to 70 ft. above the bed of the run. The cost will be between $80,000 and $90,000.—Estimates have been prepared for a 300-ft. bridge over the railway tracks at Seneca St., to cost $9,114. M. E. Rawson, Ch. Engr.—The board of control has directed the New York, Chicago & St. Louis R. R. Co. to build a bridge, 1,200 ft. long, over its tracks at Willson Ave., the bridge to be completed by July 1.

DELAWARE, O.—The following bids have been received by Lyman P. Lewis, County Audr., Delaware, for constructing a steel bridge over the Olentangy River:

Toledo Bridge Co., Toledo, O.	$3,[illegible]
Brackett Bridge Co., Cincinnati, O.	3,[illegible]
Massillon Bridge Co., Massillon, O.	[illegible]
King Bridge Co., Cleveland, O.	[illegible]
Indiana Bridge Co., Muncie, Ind. (A) $3,575 (B)	3,[illegible]
Variety Iron Works Co., Cleveland. (A) $5,200 (B)	5,700
•Bellefontaine Bridge & Iron Co., Bellefontaine, O.	4,[illegible]
Youngstown Bridge Co., Youngstown, O.	5,200
Wrought Iron Bridge Co., Canton, O.	5,275
Iron Substructure Co., Columbus, O.	4,960
New Columbus Bridge Co., Columbus, O.	4,075

•Awarded contract.

MILWAUKEE, WIS.—The council has been petitioned by Chas. Manegold, Herman Hafemeister and others for a $150,000 bridge over the Menominee Valley at 27th St.

RACINE, WIS.—The committee has voted to advertise for bids for rebuilding approaches to a number of bridges at an estimated cost of about $10,000.

SHAWANO, WIS.—The city has voted to issue $15,000 in bonds for building two iron bridges, according to reports.

DAVENPORT, IA.—Thos. Murray, Cy. Engr., writes us that a committee was recently appointed to secure subscriptions for a new bridge over the Mississippi River. Engr., C. F. Loweth, 94 East Fourth St., St. Paul, Minn.

ST. PAUL, MINN.—L. W. Rundlett, Cy. Engr., writes us that the proposed bridge at St. Anthony Park will be about 600 ft. long, and is estimated to cost $30,000. The bridge will not be constructed until next year.

LITTLE ROCK, ARK.—Theo. Hartman, Cy. Engr., writes us that the free bridge commissioners have not yet selected a plan for the $300,000 bridge over the Arkansas River at Main St. Consult. Engr., Edwin Thatcher, Louisville, Ky.

LINCOLN, NEB.—Adna Dobson, Cy. Engr., writes us that the bonds for the proposed $200,000 viaduct have not yet been issued, and there is a question of whether they will be or not. There have been several meetings of citizens, and the issuance of bonds will probably be enjoined and the matter taken into the courts.

PURCELL, IND. T.—C. D. Purdon, Prin. Asst. Engr. Atchison, Topeka & Santa Fe R. R. Co., Topeka, Kan., informs us that the company has contracted with the Edge Moor Bridge Works, of Wilmington, Del., to furnish and erect a span of 300 ft. at the crossing of the Canadian River, about 4½ miles north of Purcell. The span will have a pier, or pneumatic caisson, sunk about 45 ft. below low-water to bedrock at the north end, and a pier on pile and grillage foundation, piles sunk about 45 ft. below low-water to bedrock at its south end, the south pier being protected by a dike. The Edge Moor Bridge Works contracts also for the substructure, which will be in charge of J. E. Willard and C. L. Cornwell, of Louisville, Ky., who are now getting their machinery and material on the ground. The entire work is to be completed by April 1, 1896.

ST. THOMAS, ONT.—The Central Bridge & Engineering Co., of Peterboro, Ont., has awarded the contract for building a steel bridge 60 ft. long at Glen Colin.

BRANDON, MAN.—Bids are asked until Nov. 18 for constructing a highway bridge at 18th St. H. G. Dickson, Cy. Engr.; P. B. Durst, Chn. Bd. Pub. Wks.

BUILDINGS.

PITTSFIELD, MASS.—It is stated that a Y. M. C. A. building, to cost $100,000, is to be constructed in this city. Arch., H. Neill Wilson.

WORCESTER, MASS.—It is reported the aldermen passed an order Nov. 11 for the election by the council of a commission of three members to erect a new city hall on the common, in accordance with the plans of Peabody & Stearns, of Boston, the material to be of gray or Milford pink granite.

BUFFALO, N. Y.—The Guaranty Construction Co., of Chicago, Ill., has been awarded the contract for constructing an elevator 56 × 105 × 115 ft. for E. H. Husted & Co., at about $50,000.

NEW YORK, N. Y.—Bids are asked until Nov. 23 for improving the ventilating apparatus of the court house and post office building in this city. Wm. M. Aiken, Supervising Arch., Washington, D. C.—Henry G. Marquand, Pres. Metropolitan Museum of Art., has submitted plans to the park board for a new wing for the museum. The main part, 300 ft. × 100 ft., will be east of the main building fronting on Fifth Ave. This will be connected with the main building by an extension 100 ft. long and 50 ft. wide. There will be an entrance on Fifth Ave. between 84th and 85th Sts. The exterior of the wing will conform in detail to that of the old building, and the interior of the structure also will be similar to that of the older building.—The board of managers of St. Luke's Hospital has decided to erect a building for the study of medicine at 118th St. and Morningside Ave. to cost $200,000. Supt., Rev. Dr. Geo. S. Baker.—The Woodbridge Co. has been incorporated by Anson Phelps Stokes, 47 Cedar St.; J. N. Stokes and J. G. Stokes, John Harsen Rhoades and James W. McCulloch; capital stock, $1,000,000. The object is to acquire the land fronting on William St., between John and Platt Sts., on which it is intended to erect a 12-story office building. The property is at present occupied by several old buildings, which will soon be torn down, and it is expected that work will be begun on the new building by May 1.—Plans have been filed by Geo. W. Jenkins, of Morristown, N. J., for a five-story brick riding and bicycle academy at Central Park West and 66th St., to cost $300,000.

SYRACUSE, N. Y.—The university proposes to erect a 10-story building in Vanderbilt Square. James J.

Belden and F. G. Weeks have been appointed a committee to consider plans.

WEST HOBOKEN, N. J.—Bids are asked until Nov. 20 for erecting a stone school building on Summit Ave. Archs., Mowbray & Uffinger, 163 West 23d St., New York; Lucien P. Druck, 511 Union St., West Hoboken.

HOMESTEAD, PA.—It is reported that Andrew Carnegie will give the town a free library, costing $400,000, and will provide for its maintenance. The building will comprise a free library, reading rooms, music hall, gymnasium, club rooms, and swimming pool. The music hall will be equipped with a large organ. The building is to be completed within a year.

JOHNSTOWN, PA.—It is stated that the chief engineer of the Pennsylvania R. R. Co. has asked for bids for the erection of a new freight station at Johnstown, 40 × 200 ft.

PHILADELPHIA, PA.—W. G. Button has prepared plans for a $100,000 casino at Willow Park, for the Union Traction Co., contracts for which, it is stated, will soon be awarded.——Bids are asked until Dec. 3 for the plumbing, galvanized ironwork, repairs to railway siding, etc., for the county prison at Holmesburg Junction. Archs., Wilson Bros., Drexel Bldg., Philadelphia; Henry D. Welsh, Pres. Dept. Prisons.

PITTSBURG, PA.—It is stated that the Pittsburg & Lake Erie R. R. Co. proposes to build a new passenger and freight station on the south side of the city next year, at a cost of $1,000,000. Pres., James H. Reed.

WASHINGTON, D. C.—The Southern Ry. Co. has purchased a plot of land, 2,000 ft. long, in Alexandria, on which it is proposed to build car shops, to cost $250,000.

DURHAM, N. C.—R. H. Wright contemplates the erection of a brick and stone hotel building, to contain from 50 to 100 rooms, in this place, and will let the contract about Jan. 1.

HOT SPRINGS, N. C.—The Southern Improvement Co. will erect a hotel building in this city on the site of the one destroyed by fire recently.

LINCOLNTON, N. C.—The Lutherans of this place will build a brick and stone church building at once, according to reports.

WILMINGTON, N. C.—A site for a fertilizer works has been selected at this place, and contracts for building and equipping it have been awarded to the North Carolina Chemical Co. Address S. T. Morgan, Durham, N. C., President of the company.

NEW ORLEANS, LA.—L. W. Brown, Cy. Engr., is preparing plans for a five-story city hall, according to reports.

COLUMBUS, O.—Arrangements are being made to begin the construction next spring of a new union railway station. It is reported that a viaduct, to cost about $700,000, will also be built. D. S. Gray, Pres. Union Depot Co.

INDIANAPOLIS, IND.—The Odd Fellows are proposing to tear down their lodge building and erect a large modern office building on the site.——McPherson & Bowman have had their plans adopted for the Illinois Normal School building at Charleston, 320 × 90 ft., with a rear projection 70 × 100 ft. The wing is 50 ft. high, and the main tower in front 140 ft.——Louis H. Gibson has just completed plans for an apartment house on Pennsylvania St., to cost about $25,000, for Carson & Chenoweth.

SOUTH BEND, IND.—The county commissioners have received the following bids for constructing a court house; W. E. Myler, Deputy Audr.; Arch., A. W. Rush, Grand Rapids, Mich.:

C. Boseker & Son, Fort Wayne, Ind.	$231,566
Barnett & Record Co., Chicago, Ill.	241,300
D. Werst & Son, South Bend	248,000
McCormick & Co., Columbus, Ind.	249,750
South Bend Lumber & Bldg. Co.	255,989
J. E. Gibson & Co., Logansport, Ind.	268,136
McArthur Bros., Chicago, Ill.	273,285
James A. McGonigle, Chicago	295,850
A. G. Campfield & Co., Richmond, Ind.	222,786
Long & Penn, Cadiz, O.	235,878

Bids for special parts were received from the following: Sulzer-Vogt Machine Co., Louisville, Ky., electric elevator, $1,823; Stevens & Redwards, Logansport, Ind., steam heat, plumbing and gas fitting, $11,623; G. L. March & Son, South Bend, roofing, $11,500; H. P. Blair & Co., South Bend, heating, plumbing and gas fitting, $11,250; Isaac B. Smead, Toledo, O., warming and ventilating, $5,100; Conant Bros., Grand Rapids, Mich., furniture for building, $12,878; Litho-Marble Decorating Co., Chicago, marble and mosaic tile, $26,370; Geo. D. Barnhard & Co., St. Louis, Mo., steel vault furniture, $6,107; S. D. Moran, South Bend, electrical work, $1,460.

CHICAGO, ILL.—It is reported that the College of Physicians & Surgeons, through its secretary, Dr. Bayard Holmes, has made an offer to the Woman's Christian Temperance Union to erect a building to cost $150,000 under such conditions that payment will be easy. The proposition from the college is to furnish the Woman's Christian Temperance Union with a hospital, which shall be conducted on the same lines as is the hospital now under its management.

LAWRENCEVILLE, ILL.—Bids are asked until Nov. 22 for putting a system of heating in the court house and jail of Lawrence county. J. K. White, County Clk.

CHEROKEE, IA.—It is stated that the board of commissioners for the new insane hospital that will be erected here next summer will meet at Des Moines Nov. 20 for the purpose of adopting plans and specifications for the new building, which will be erected at a cost of $1,000,000. Gen. Ed Wright, of Des Moines, is a member of the commission.

MILWAUKEE, WIS.—The supervising architect at Washington has received the following bids for the steel and iron work above the attic floor for the U. S. public building in this city:

		Time.
Wm. Bailey & Sons Co., Milwaukee	$39,000	180 days.
Brown-Ketcham Iron Wks. Co., Indianapolis	39,788	6 months.
Wisconsin Bridge & I. Co., Milwaukee	39,750	"
Youngstown Bridge Co., Youngstown	*	"
Milwaukee B. & I. Wks., Milwaukee	34,400	"
Snead & Co. I. Wks., Louisville, Ky.	41,604	"

* Informal, bid per pound.

LE SUEUR CENTER, MINN.—L. M. Curry, of Chicago, Ill., has been awarded the contract for building a stone court house at this place at $35,000.

ST. PAUL, MINN.—The capitol commission has adopted the plans of Cass Gilbert, of St. Paul, for a new state capitol building in this city. Prizes were awarded as follows, for the next best plans: George R. Mann, of St. Louis, first premium, $1,000; Traphagen & Fitzpatrick, of Duluth, and E. P. Bassford, of St. Paul, second prize, $800; Clarence H. Johnston, of St. Paul, third prize, $700; Harry W. Jones, of Minneapolis, fourth prize, $500.

ST. LOUIS, MO.—D. H. Burnham, of Chicago, Ill., has been engaged to prepare plans for a 10-story office building at Fourth and Market Sts., for Rutledge & Kilpatrick.

SAN FRANCISCO, CAL.—Architects have been engaged to prepare plans for three buildings for the Affiliated Colleges, to cost $250,000. Oliver P. Evans, of the Hastings College of Law, is interested.

SANTA FE, N. MEX.—The committee is considering plans prepared by I. H. Rapp, of Rapp Bros., Chicago, Ill., for rebuilding a portion of the state capitol, at a cost of about $175,000. Pres., F. A. Manzanares; Secy., A. Staab.

SEATTLE, WASH.—Plans have been prepared for rebuilding the shops of Northern Pacific Ry., burned recently, at a loss of $120,000. It is stated that the new shops will cost $135,000.

WATER-WORKS.

ACTON, MASS.—W. D. Tuttle, of the water board, writes us that preliminary surveys and estimates will soon be ready for publication, after which the town will be called upon to act upon the subject. Engr., F. L. Fuller, of Boston.

HATFIELD, MASS.—J. B. Lowell, Chn. Comrs., writes us that E. C. & E. E. Davis, of Northampton, are preparing plans for the proposed works, estimated to cost about $30,000. The supply will be by gravity, and no pumps, stand-pipes, meters or filters will be required.

HOLYOKE, MASS.—The commissioners are considering a gravity supply from Manhan Brook, 10 miles distant, at an estimated cost of $250,000. Engr., James L. Tighe.

TURNER'S FALLS, MASS.—The fire district has voted to extend the mains to Montague City, at an estimated cost of $4,680, as noted last week.

SHARON, MASS.—It is reported that $21,000 of 4% water bonds have been sold at 102.79.

MERIDEN, CONN.—The council has voted to begin work as soon as possible upon the new reservoir, noted in our issue of Oct. 31. E. B. Moss, Cy. Engr.

NEW HAVEN, CONN.—The New Haven Water Co. writes us that no steps have yet been taken for an additional water supply other than to bring condemnation proceedings to acquire land for additional flowage at the lake in East Haven. During the last year the company has purchased a 10,000,000-gallon Worthington pump and laid an additional 24 and 20-in. main from Lake Whitney.

ALBANY, N. Y.—Bids are asked until Nov. 18 for steam piping and connecting boilers with pumping engines. Geo. I. Bailey, Supt.——The contract for a new steel intake across the basin, about 350 ft. of 5-ft. pipe, has been awarded to the Johnson & Hilt Co., the bids being as follows:

The Johnson & Hilt Co., Albany, N. Y.	$14,745
C. A. Cregan, New York, N. Y.	37,249
M. J. Dady, Brooklyn, N. Y.	32,188

AKRON, N. Y.—H. H. Newton is secretary of the newly appointed board of water commissioners. No engineer had been engaged Nov. 6. The works will cost not to exceed $30,000, and the construction is to be commenced as soon as possible. James G. Childs is Village Clk.

BOONVILLE, N. Y.—The construction of works continues to be agitated. It is stated that a water supply has been found two miles distant, and an elevation of 190 ft. above the village. No estimates have yet been prepared or election held.

CASTLETON, N. Y.—The village trustees are reported as discussing the question of constructing works.

MONTICELLO, N. Y.—The water-works plant has been completed and successfully tested. The contract was awarded to the Wild Engineering Co., 39 Cortlandt St., New York, in June, at $18,815. John A. Miller, Engr., Goshen, N. Y.

LIVINGSTON MANOR, N. Y.—A press report states that W. H. Cowan has been in town making surveys for works.

SARANAC LAKE, N. Y.—An election will be held Nov. 19 to vote on the question of issuing $10,000 in bonds to extend the works.

NORTH JAVA, N. Y.—Ira Adams writes us that the question of constructing works in the near future is under consideration, but that very little or nothing has yet been done, except to discuss the question.

VAILSBURG, N. J.—We are informed that Eugene A. McMurray, of Newark, has been engaged to examine the different systems of water supply, and prepare a report showing the comparative cost and merit of each system as adapted to the requirements for supplying the upper section of this place.

ASHLAND, PA.—The council has accepted a report recommending the construction of a new reservoir dam to cost $15,000.

DALTON, PA.—It is reported that a water company is being organized to construct works, the supply to be from artesian wells on the west side of the town.

DILLSBURG, PA.—It is reported that the citizens voted last week on a proposition to issue $10,000 in bonds for works.

GROVE CITY, PA.—W. J. Harshaw, Secy. Grove City Water Co., writes us that works will not be constructed until spring.

SUMMERHILL, PA.—The borough council is reported as about evenly divided in regard to a proposition to construct works, estimated to cost about $10,000.

MALVERN, PA.—The citizens have voted to increase and improve the water supply.

McKEESPORT, PA.—Emanuel Wolf, Secy. Comrs., writes us that the Wagner Water Supply Co., of Dayton, O., has put down two test wells, one of which cannot be pumped dry, and is now working on a proposition to furnish the city with 5,000,000 gallons a day. The city is very anxious for a better water supply.

LOFTY, PA.—The Lehigh Valley Co. is reported as constructing a reservoir at Delano, and as having plans and specifications prepared for one at this place.

ROCHESTER, PA.—At the election Nov. 5 the citizens voted to issue $60,000 in bonds for new works.

WESTON, W. VA.—The citizens are reported as in favor of constructing works.

MARIETTA, GA.—The Marietta Paper Mfg. Co., noted Oct. 31 as having been granted a franchise for water-works, writes us that O. G. Gillet is preparing plans and specifications, and that bids will be received when these are completed. The supply will be pumped from a creek; population, 4,000.

ATHENS, ALA.—Steps are being taken to secure the construction of a complete system of water-works for the Athens Female College.

SHEFFIELD, ALA.—There is talk of constructing works and an electric light plant.

GREENVILLE, MISS.—Bids are asked until Dec. 16 for furnishing materials and constructing works, as described in our advertising columns. John M. Lee, Cy. Clk.

BAY ST. LOUIS, MISS.—Bids are asked until Nov. 30 for the construction of works. Address the city secretary.

HENDERSON, KY.—The commissioners are reported about to erect a stand-pipe 20 × 100 ft.

LOUISVILLE, KY.—The Michigan Brass & Iron Co., of Detroit, represented in this city by the Ahrens & Ott Mfg. Co., has been awarded the contract for a supply of fire hydrants at $19,000.

PADUCAH, KY.—A proposition to issue $20,000 in bonds to build municipal works was defeated Nov. 5. It is stated that a majority of the citizens are satisfied with the present service.

RUSSELLVILLE, KY.—The city clerk writes us that no water-works are contemplated at present in this city.

CLEVELAND, O.—Bids are asked until Dec. 11 for furnishing and erecting a 20,000,000-gallon pumping engine, as described in our advertising columns. M. W. Kingsley, Supt.; D. E. Wright, Dir. Pub. Wks.

MILFORD, O.—It is reported that there is little opposition to the proposed water-works improvements.

MONROEVILLE, O.—J. F. Henninger, Clk., writes us that the water-works proposition lacked three votes of the necessary two-thirds, and that the indications point to another election in the near future.

CRAWFORDSVILLE, IND.—The circuit court has directed William P. Fishback, Master in Chancery, to sell the water company's plant Dec. 14.

EVANSVILLE, IND.—Bids are asked until Dec. 5 for constructing pump, well, etc., and three lines of cast iron intake pipes, as described in our advertising columns. The bids recently received for this work were published under Water-Works in our issue of Oct. 24. L. Weinheimer, Clk. Bd.

MARENGO, IND.—The town board is reported to have decided to construct works to cost $25,000.

MIDDLETOWN, IND.—Bids are asked until Dec. 5 for constructing works. Engr., T. C. Hefel, Muncie; J. O. Lambert, Pres. Bd.

MARSHALL, MICH.—A committee has been appointed to submit plans for works at a meeting of the council Nov. 18, and the report states that bids will then be asked for the construction.

CHARLESTON, ILL.—The council is considering specifications for a masonry dam 125 ft. long. It is stated that a temporary dam will be built at once, and the masonry dam in the spring.

UPPER ALTON, ILL.—P. S. Webster, Village Clk., writes us that Geo. C. Morgan, of Chicago, was the only bidder for constructing works. The contract has not yet been awarded.

BERLIN, WIS.—Henry Morman, Cy. Clk., writes us that a water-works franchise was granted Nov. 6 to W. H. Wheeler & Co., of Beloit, Wis. The city is to pay $4,500 a year for 80 hydrants, and has the privilege of purchasing the plant when completed for $60,000.

GREEN BAY, WIS.—Fairbanks, Morse & Co., of Chicago, have been awarded the contract for constructing works at the new county almshouse at about $3,000.

LE SUEUR, MINN.—Bids are asked until Nov. 23 for the purchase of $20,000 in 5% 20-year water and light bonds. C. L. Martin, Cy. Clk.

WAUWATOSA, WIS.—The trustees are reported about to advertise for bids for constructing works. Myron Gilbert, Cy. Clk.

DES MOINES, IA.—F. M. Hubbell, the principal owner of the works, has sold his interest to C. S. Parks, of Boston, representing a company that is reported to control over 1,400 water-works plants. It is stated that the income of the works is $130,000 a year, consisting of $75,000 from the people and $55,000 from the municipality, the operating expenses being about $35,000 a year. Some of the citizens are agitating the question of constructing municipal works.

ELGIN, IA.—Plans for works are being prepared by Crellin & Lovell, of Des Moines.

SIOUX CITY, IA.—The superintendent has been directed to prepare specifications for laying about 150 tons of new mains.

PRESTON, MINN.—The citizens voted Nov. 7 to issue $13,500 in bonds for works. W. R. Todd, Mayor.

FAIRVIEW, S. DAK.—It is reported that bonds have been voted for an artesian well.

FORMAN, N. DAK.—Bids are asked until Dec. 2 for sinking three artesian wells, and also for the purchase of $5,500 in 7% bonds. F. H. Purdy, Clk.

INDEPENDENCE, MO.—The superintendent is reported as stating that $65,000 worth of improvements should be made to the plant within a year or two. This includes larger reservoirs, additional pumping machinery, etc.

MARCELINE, MO.—The citizens of this place are reported as agitating the question of water-works.

ST. CHARLES, MO.—The council is considering a resolution authorizing the mayor to secure plans and estimates for new works.

CALMAR, IA.—Bids are asked until Nov. 16 for the purchase of $1,500 in 6% water bonds. G. A. Meyer, Town Treas.

ST. LOUIS, MO.—The board of public improvements has recommended an appropriation of $85,000 for the purchase of water pipe, valves, etc., and $32,000 for laying the same.——The Camden Water, Light & Power Co., of this city, has been incorporated, with a capital stock of $50,000, by F. W. Paramore, H. F. Mueller, E. E. Paramore and Chas. Brown.

UNIONVILLE, MO.—The citizens have voted 303 to 41 in favor of water-works.

EAGLE PASS, TEX.—The franchise and plant of the Eagle Pass water-works has been sold to L. Debona.

FORT WORTH, TEX.—The council has voted to issue $10,000 in bonds for extensions of the water-works.

GALVESTON, TEX.—The council has appropriated $28,000 for extending the mains along the wharves.

MOUNT VERNON, WASH.—An election will be held Nov. 29 to vote on an issue of $14,000 in bonds for water-works, as noted in our issue of Oct. 24. John L. Anable, Cy. Clk.

NEWBERG, ORE.—Bids are asked until Dec. 2 for the purchase of $15,000 in 5% 20-year bonds, unanimously voted for a gravity system of water-works; population, 1,100. J. G. Hadley, Cy. Recdr.

ST. LAMBERT, QUE.—The taxpayers are reported to have voted on a proposition to issue $70,000 in bonds for a system of water-works and drainage.

HAMILTON, ONT.—A report on proposed improvements to the works has been made by E. H. Keating, Cy. Engr., of Toronto. Mr. Keating recommends that the city be divided into high and low service levels, the dividing line to be approximately the 50-ft. contour above city datum. New and larger mains are proposed as substitutes for small ones, and also new pumping engines. The main items in the $263,000, the estimate for improvements, are as follows: Two 6,000,000-gallon pumping engines, with boilers, $70,000; pumping station, $22,500; 15,800 ft. 20-in. pipe, 1¼ ins. thick, at $4.50 per ft. in place, $71,100; 32,800 ft. of 12-in. pipe, ⅝ in. thick, laid, $52,000. The balance of the estimate is for smaller pipe, valves and other accessories. Wm. Haskins is city engineer of Hamilton.

IRRIGATION.

CHEYENNE, WYO.—President Melville, of the Wyoming Irrigation & Land Co., of this city, is reported as stating that the company intends at a cost of $250,000, during the next three years to construct a dam and a number of reservoirs, canals and laterals to irrigate 200,000 acres additional to the land now being covered.

PHOENIX, ARIZ.—Press reports state that work will soon be begun on the dam of the Hudson Reservoir Co. on Salt River, 60 miles above Phoenix. The dam will make a reservoir with ample water-storage capacity for the irrigation of 1,000,000 acres of land. Its cost will not exceed $2,000,000, as all natural conditions are favorable. Pres., Henry C. Mann, of New York, N. Y.

MINIDOKA, IDAHO.—T. D. Babbitt, of Boise City, has been making surveys for the state engineer for two canals, one on each side of the Snake River, commencing near Minidoka and extending about 30 miles down the river. It is proposed by the state to irrigate by these canals about 100,000 acres. F. J. Mills, State Engr., Boise City.

NEW COMPANIES.—Pacific Water Co., Kings City, Cal.; $300,000, with $200,000 paid in; Wm. E. Ward, Benj. S. Coppock, H. V. Moorehouse, A. L. Burbank, of San Jose, Cal.

Covina Land & Water Co., Los Angeles, Cal.; $25,000, with full amount paid in; H. E. Huntington, Wm. Hood, San Francisco, Cal.; J. H. Coolman, Covina, Cal.; J. A. Muir, F. E. Prior, of Los Angeles.

South Tule Independent Ditch Co., Porterville, Cal.; $24,000, with $22,400 paid in; to build dams, tunnels, levees, etc., for irrigating purposes; A. Rand, W. P. Putnam, H. Lees, J. C. McCabe, H. S. Witt, Porterville.

Paladale Town Co., Los Angeles, Cal.; $100,000, with full amount paid in; to build ditches, canals, reservoirs, etc., for irrigation purposes; L. G. Parker, Nathan Cole, Jr., Z. T. Cole, C. M. Persons, J. A. Anderson, Jr., of Los Angeles.

Siera Development Co., Sansalito, Cal.; $250,000, with $2,500 paid in; to build dams, reservoirs, ditches, etc., for irrigation; M. F. Hudson, Oakland, Cal.; E. H. Rixford, T. B. Kent, H. C. Campbell, of San Francisco, Cal.; O. C. Miller, Sansalito.

West Side Suburban Water Co., Los Angeles, Cal.; $2,000,000, with $7,000 paid in; to build dams, ditches, canals, etc., for irrigation; C. E. Brook, C. W. Buchanan, John McDonald, Pasadena, Cal.; W. P. Montgomery, E. C. Hine, of Los Angeles.

Washoe Irrigation & Power Co., Washoe, Idaho; $20,000; to construct a canal in Canyon county, taking water from the Payette River for irrigating the lands in the Washoe bottom; Stillman Mack, W. W. Paine, Washoe, Idaho; James T. Clements, Ontario, Ore.

SEWERAGE.

SOMERSWORTH, N. H.—Ames & O'Shea, of Rochester, N. H., have been awarded the contract for constructing pipe sewers, at about $14,000. Engr., F. S. Berry; A. A. Perkins, Chn. Com.

ARLINGTON, MASS.—The sewer committee has recommended an appropriation of over $100,000 for a system. A town meeting will be held Nov. 14 to consider the question.

BROOKLINE, MASS.—A. H. French, Town Engr., informs us that the following bids were received Nov. 11 for building brook channel and sewers; the itemized bids will be published next week:

* King & Hodge, Brookline	$19,526
** M. J. O'Hearn, Brookline	19,783
Dennis Driscoll, Brookline	22,432
D. F. O'Connell, Boston, Mass.	23,592
Metropolitan Construction Co., Boston, Mass.	26,100
Jas. Driscoll, Jr., Brookline, Mass.	27,017
T. J. Kelly, Brookline, Mass.	27,296
P. H. Bryne & Co., Malden, Mass.	27,649
Craib & Trumbell, Winthrop, Mass.	29,190
F. A. Snow, Brookline, Mass.	29,005
N. McBride, Brighton, Boston	32,087

* Informal. ** Awarded contract. Engineer's estimate, $27,825.

NORTH BROOKFIELD, MASS.—It is proposed to construct a system, at an estimated cost of about $80,000, to accommodate the entire town, with the exception of Bell and Warren Sts. and the lower village.

TAUNTON, MASS.—The sewer commissioners have reported a plan for a trunk sewer system, and have called for a preliminary appropriation of $125,000 with which to begin work next spring. It is proposed to put in a trunk sewer from Whittington Junction to Blake's Landing, below the Weir, about six miles. The entire work will cost about $300,000. The sewage will enter Taunton River below the thickly settled portion of Weir village. Consult. Engr., Rudolph Hering, 277 Pearl St., New York, N. Y.; Henry A. Thayer, Henry S. Culver, Wm. R. Billings, Commissioners.

WAKEFIELD, MASS.—A committee of seven has been appointed to make a report in March on the advisability of constructing a sewer system.

WATERTOWN, MASS.—It is reported that the selectmen have decided to build a main sewer in West Watertown.

BROOKLYN, N. Y.—Bids are asked until Nov. 22 for constructing main sewers in two streets. Alfred T. White, Comr. Cy. Wks.

DUNKIRK, N. Y.—A public meeting is to be held Dec. 21 to consider the question of constructing an intercepting sewer along the lake front.

GENEVA, N. Y.—E. W. Huendun, Pres. Sewer Comrs., writes us that the commissioners have detail working plans for the proposed sewers, but they have no awarded any contracts yet, as no money has been appropriated. It is proposed to ask for an appropriation from the city early in the winter.

HAVERSTRAW, N. Y.—An election is to be held Nov. 19 to vote on the question of constructing sewers.

NIAGARA FALLS, N. Y.—The following bids have been received for constructing a main sewer 1,865 ft. long; W. W. Read, Cy. Engr.: Banks & Ingalls, $17,010; R. D. Young, $15,852; A. C. Douglass, $14,667; Clement & Co. (awarded contract), $13,986.

IRVINGTON, N. J.—Hedenberg & Kinsey, 106 Fulton St., New York, N. Y., have recommended the intermittent filtration system of sewage disposal at an estimated cost of about $50,000, according to reports.

PATERSON, N. J.—Bids are asked until Nov. 16 for constructing a sewer in North Sixth St. Thos. McLean, Cy. St. Comr.

OWENSBORO, KY.—It is reported that an election is to be held to vote on the question of issuing $25,000 in bonds for sewers, $25,000 for street improvements, etc.

BOWLING GREEN, O.—It is stated that the question of sewage disposal is being considered.

CANTON, O.—L. E. Chapin, Cy. Engr., writes us that an election may be held in the spring to vote on the question of issuing bonds for constructing the Shriver's Run sewer. The sewer will be 78 ins. in diameter, one mile long, and is estimated to cost about $55,000.

WARREN, O.—The state board of health has approved the plans for additional sewers and a sewage disposal system. C. O. Probst, Secy. State Bd. Health, Columbus; F. S. Chryst, Solicitor, Warren.

INDIANAPOLIS, IND.—The construction of an intercepting sewer 2½ miles long in the Pleasant Run district is being considered. Consult. Engr., Rudolph Hering, New York.

AURORA, ILL.—The construction of a system, estimated to cost $15,000, in the west side, is being discussed.

MADISON, WIS.—Bids will probably soon be asked for the construction of a sewer system and sewage disposal works, as described in our issue of Oct. 24. McClellan Dodge, Cy. Engr.

OSHKOSH, WIS.—The board of public works is considering the question of constructing sewers in the district about New York Ave. and Bowen St.

COLUMBIA, MO.—The sewer committee has recommended the construction of two main sewers, to cost about $10,000. Consult. Engr., H. T. Cory, of Columbia.

KANSAS CITY, MO.—H. H. Filley, Cy. Engr., writes us that the first ordinance for constructing a sewer, to cost $40,000, has been defeated in the council. Another ordinance has been introduced, but it will be too late to do any work this year.

ST. JOSEPH, MO.—The city engineer has been directed to advertise for bids for constructing 15 to 10-in. pipe sewers in several streets. Chas. S. Shepherd, Cy. Clk.

CRIPPLE CREEK, COLO.—The Cripple Creek Sewerage Co. has been incorporated to build a sewer system in Cripple Creek; capital stock, $100,000; incorporators, William Geddis, James M. Parker, George N. Steinmetz, James L. Lindsey and Herbert J. Reid.

DENVER, COLO.—The aldermen have voted to construct a sewer system on the south side.

SAN FRANCISCO, CAL.—The street committee of the supervisors has been petitioned by the property owners south of Golden Gate Park to appropriate $10,000 for making surveys for a system in that portion of the city. Taylor Rogers, Mayor's Clk., informs us that no appropriation has yet been made, but some action will probably be taken soon. Adolph Sutro, Mayor.

ST. LAMBERT, QUE.—It is stated that an election was held Nov. 2 to vote on the question of issuing $70,000 in bonds for a sewer system and water-works.

GARBAGE DISPOSAL.

HARTFORD, CONN.—The Bridgeport "Farmer" states that a Holthaus garbage crematory will probably be erected in this city at an early date. The plant will be similar to the one being built in Bridgeport, only larger.

ALBANY, N. Y.—The Albany Reduction Co. was incorporated Nov. 8, and has made a proposition to the board of health to dispose of the garbage of the city; capital stock, $150,000; directors, Jonas H. Brooks, John Wagner, E. J. Duggan, Chas. M. Page, Gilbert L. Pearsall and J. F. Farrell. The principal stockholder is Hascal A. Hogle, of Port Chester, who takes 735 shares, and whose system it is proposed to adopt.

ATLANTA, GA.—The board of health urges an appropriation for one or two more garbage crematories.

CLEVELAND, O.—The National Extraction Co. has been incorporated with a capital stock of $100,000 by Alexander S. Ramage, Henry W. King, David J. Kurtz, John M. Gundry and Sheldon H. Tolles, to extract oils, grease, etc., from refuse and other products.

STREETS AND ROADS.

BOSTON, MASS.—Bids are asked until Nov. 18 for 6,600 sq. yds. of macadam paving in Blue Hill Ave., as stated in our advertising columns. B. T. Wheeler, Supt. Sts.

WARE, MASS.—A town meeting was held Nov. 4 to consider the question of authorizing the selectmen to petition the state highway commission to build about two miles of macadam road.

WORCESTER, MASS.—The street committee has decided to engage an engineer to prepare plans for improving the streets. Samuel E. Winslow, Chn. Com.; Frank E. Haywood, Secy.

BRIDGEPORT, CONN.—The mayor is to petition the board of apportionment in January for an appropriation of $75,000 for asphalt paving.

MERIDEN, CONN.—The question of appropriating $35,000 for paving next year is being discussed. E. K. Moss, Cy. Surv.

ALBANY, N. Y.—Bids are asked until Nov. 18 for brick paving in Central Ave.; two sureties of $20,000 each. Thos. J. Lanahan, Clk. St. Dept.

WHITE PLAINS, N. Y.—The county supervisors will hold a meeting Dec. 2 to consider the question of constructing roads. Francis M. Carpenter, New Castle, Chn.; Joseph See, North Castle, Supervisor.

ALLEGHENY, PA.—At an election held Nov. 5 it was voted to issue $400,000 in bonds for street improvements. W. M. Kennedy, Mayor.

AMBLER, PA.—It is stated that an election will probably be held to vote on the question of issuing $40,000 in bonds for improving the streets. Wm. G. Griffiths, Pres. Council.

PHILADELPHIA, PA.—Bids are asked until Nov. 19 for regrading and repaving in a number of alleys. Theo. B. Stulb, Health Officer.——Bids are asked until Nov. 19 for grading and paving streets; also for repairing and painting bridges, etc. Thos. M. Thompson, Dir. Pub. Wks.

PHILADELPHIA, PA.—The director of public works and the chief of the bureau of surveys have decided to pave portions of 64 streets with asphalt, six with granolithic, 23 with blocks, and seven with brick. The work will be begun next spring, and is estimated to cost $500,000.

SCRANTON, PA.—The question of paving Abington Road with brick or asphalt, at an estimated cost of $100,000, is being discussed by the council. J. E. Roche, Wm. Streater and Norman Leach can be addressed.

RICHMOND, VA.—The council has voted to appropriate $40,000 for street improvements.

JACKSONVILLE, FLA.—The board of public works has been petitioned to pave Newman St. with brick. A. F. Harley, Cy. Engr.

CINCINNATI, O.—Bids are asked until Nov. 18 for asphalt paving in two streets. A. P. Butterfield, Clk. Bd. Administration.

NORWOOD, O.—Bids are asked by J. M. Harper, Ninth and Plum Sts., Cincinnati, until Nov. 23 for macadamizing Waverly Ave. W. E. Wichgar, Clk. Council, Norwood.

TOLEDO, O.—Bids are asked until Dec. 2 for paving South St. L. P. Harris, Cy. Clk. Some of the bids recently received for paving this street were as follows, these bids being rejected as too high: Trinidad asphalt, H. P. Streicher, $43,208; Warren-Scharf Paving Co., $39,900; cedar block, H. P. Streicher, $20,230. Wm. McMahon, $19,414; brick, J. & C. W. McKinney, $18,418; Athens block, C. H. Sawyer, $25,998; Townsend block, H. G. Jennison, $21,588; East Clayton block, F. E. Cole, $23,753.

TERRE HAUTE, IND.—Bids are asked until Nov. 19 for brick paving in Fourth St. Chas. H. Goodwin, Cy. Clk.

QUINCY, ILL.—The council has been petitioned to pave South Eighth St. with brick.

MINNEAPOLIS, MINN.—The committee has recommended the council to advertise for bids for paving a portion of Bridge Square with brick.

KERN CITY, CAL.—The trustees of this city are reported as considering the question of making a number of street improvements.

LOS ANGELES, CAL.—C. A. Luckenbach, Cy. Clk., writes us that all the grading, paving and sewer work carried out by the city is done by direct assessment under a state law. The contracts are always let in small jobs.

MANUFACTURING PLANTS.

WATERVILLE, ME.—Purinton Bros. have been awarded the contracts for the buildings for the Webber & Philbrook Co.'s plant, consisting of a machine shop 50 × 80 ft., and two stories high; foundry, 45 × 80 ft.; boiler house, 24 × 30 ft., and store house, 40 × 45 ft., two stories high. The buildings are to be ready for occupancy by Dec. 15.

MANCHESTER, N. H.—The Manchester Mills is reported about to erect a large cotton mill on the east side of the Merrimack; the proposed building will be over 100 ft. long, six to seven stories high, will employ 700 or 800 people, and will cost $600,000 to $700,000.

HARTFORD, CONN.—A report states that the National Woven Wire Mattress Co. will build a brick addition to its plant on Center St., one story, 40 × 100 ft. Pres., W. T. Fielding.

NEW HAVEN, CONN.—A report states that the Winchester Repeating Arms Co. will soon erect a factory 300 × 60 ft., and three stories high, to be built of brick on the slow-burning plan, and to be devoted to the manufacture of paper shot shell. A brick structure will also be built 150 × 50 ft., to be used for drying the paper tubes.

BROOKLYN, N. Y.—Press reports state that the Mergenthaler Linotype Co. will build a machine shop on the east side of Hall St., north of Park Ave., to cost $35,000.

FLUSHING, L. I., N. Y.—It is reported that Thomas Skeuse is interested in a plant to be established here to manufacture hygienic ice, to cost $40,000.

ALLENTOWN, PA.—Philip Schneider is reported as having purchased a site at Jefferson and Pine Sts., where he will erect a new factory, 60×100 ft., in the spring; the motive power of the new factory will probably be electricity. Mr. Schneider now has a factory at 19-23 South Hall St.

NORRISTOWN, PA.—The Wyoming cotton mills of Dean & Mitchell were recently damaged by fire to the extent of $50,000, according to a press report.

READING, PA.—The Penn Hardware Co. will, according to report, commence the erection of a building on east side of River St., between Spruce and Bingaman Sts.; four stories, brick, 50×125 ft., and a foundry, 52×125 ft.

PHILADELPHIA, PA.—A press report states that Edwin K. Davis is to install a plant for the extraction of oils from wool, for C. F. Simonson's Sons, on the south side of Tioga St., between Belgrade and Gaul Sts. The plant will consist of a one-story brick boiler and storage house, 50×106 ft.; a one-story brick office, 14×28 ft.; a one-story stable, 14×28 ft., and a one-story brick building, 65×50 ft.——Philip Haibach is to erect an ice manufacturing plant, 26×72 ft., at Emlinson St. and Trenton Ave., for Joseph Straubmuller.

PITTSBURG, PA.—The Schoen Mfg. Co. has bought three acres of ground adjacent to its works, on which will be erected new shops for the manufacture of its pressed steel specialties.——The Pennsylvania Sash & Door Co. will erect a large brick warehouse on Second Ave. and Tenth St.

FAYETTEVILLE, N. C.—A press report states that L. W. Holt has given a contract for 500,000 brick for a $300,000 cotton factory, to be built here. The deed for the site is signed and factory practically commenced. A large bleachery will also be established at Fayetteville.

AUGUSTA, GA.—A report states that the Augusta Factory will spend $75,000 on improvements, and that bonds have been issued for that amount.

FLORENCE, ALA.—The Cherry Cotton Mill, of this place, according to reports, will build an additional mill next year. C. E. Cowarden will prepare plans for the buildings.

ANDERSON, IND.—It is reported that the Culver Locomotive & Boiler Works, of Brooklyn, will locate in this city, a deal having recently been completed whereby the citizens of Anderson purchased 300 lots to secure the plant.

PORTER, IND.—It is understood that the Merchants' Dispatch Transportation Co., located at Park Manor, Ill., has signed a contract to move its works to Porter. Ground will be broken for the erection of the buildings this month, and the plant will be removed there in the spring. Over 200 men will be employed.

GRAND RAPIDS, MICH.—The Union Foundry Co. is about to enlarge its plant.

CHICAGO, ILL.—T. Schoenhoefen Brewing Co., corner Canalport Ave. and West 18th St., will erect a two-story brick and stone beer stock house at 31 South Ward St., to cost $35,000. Archs., Louis Lehle Co., Randolph St.

HAMILTON, ILL.—Dickinson & Bartlett's planing mill was recently destroyed by fire. Reported loss, from $25,000 to $30,000; insurance, $8,000. It is said that the mill will be rebuilt.

ROCK FALLS, ILL.—Jacob Smith and Charles Young have purchased the old mill property at Lyndon, and will establish a paper mill. Workmen will at once take down the brick of the old mill to the first story, and the necessary additions will be made and new machinery purchased. Steam power will be used to operate the plant.

APPLETON, WIS.—It is stated that the Western Paper Bag Co. will build a large pulp mill at the Croche, which is a few miles below Kaukauna, and that architects are now preparing the plans. Wm. Van Nortwick, of Batavia, Ill., is said to be interested.

ARGENTINE, MO.—The Consolidated Smelting & Refining Co. has purchased ground in Franklin Heights, this city, and will erect a building at once for a copper-refining plant.

ST. JOSEPH, MO.—The plant of the St. Joseph Pump Co., which was recently burned, will be rebuilt at an early date. It is stated that the new manufactory will employ a large number of men, and will be equipped with the latest approved machinery.

ST. LOUIS, MO.—The plant operated by the St. Louis Granite Co., at Granite City, Ill., will soon be enlarged by an addition to the steel plant and the erection of a power house for furnishing electricity. The improvements will cost $300,000, and plans are being prepared by J. L. Wees, Arch.

DENVER, COLO.—The Sunnyside Extension Mining & Milling Co., operating the Sunnyside Extension mine, in Mastodon gulch, San Juan county, will, a report states, add 20 stamps to its mill next season, thereby doubling its present capacity.

SPOKANE, WASH.—It is reported that the Northern Pacific R. R. has decided to locate its car shops in this city, and will at once commence the erection of the following buildings, to be built of brick and stone: A 22-stall roundhouse, 70 × 300 ft., in circular form, machine shop, 60 × 150 ft.; storeroom, 50 × 100 ft., and woodworking shop, 60 × 300 ft. The buildings will be lighted by electricity, and from 50 to 75 HP. will be needed to operate the machinery.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

DERRICKS.—West Rutland, Vt.—The Vermont Marble Co. is in the market for several new derricks. Geo. Robinson, Supt.

FIRE ENGINE.—Chetopa, Kan.—Bids are asked by the council until Nov. 20 for a new fire engine, according to press reports.

DREDGING.—San Francisco, Cal.—Bids are asked until Dec. 2 for dredging in the Mokelumne River. Maj. W. H. Heuer, U. S. Engrs.

ROCK CRUSHER.—Cleveland, Tenn.—It is reported that the city is contemplating the purchase of a rock crusher at a cost of $1,200.

ROAD ROLLER.—Woburn, Mass.—The council has concurred in an appropriation of $13,000 for a road roller, according to reports.

RAILWAY TIES.—Moncton, N. B.—Bids are asked until Nov. 27 for a supply of ties and switch ties for the Intercolonial Ry. D. Pottinger, Gen. Man.

LAYING CABLE IN CHILE.—Bids will be received at the Chancery of the Legation of Chile, at Washington, until Dec. 5, for laying a cable from Puerto Montt to Punta Arenas, Chile.

DREDGING.—Wilmington, Del.—Bids are asked until Dec. 10 for dredging in Christiana River, Wilmington Harbor, as stated in our advertising columns. Maj. Wm. F. Smith, U. S. Agent.

STEAM ROLLER AND STONE CRUSHER.—Sheboygan, Wis.—The board of public works is reported to have been instructed to investigate the advisability of buying a steam road roller and a stone crusher to be used for macadamizing the streets.

STATE CANAL IMPROVEMENTS.—Albany, N. Y.—At the election Nov. 5, the state voted to appropriate $9,000,000 for improving the state canals. About $4,000,000 of this will soon be available, and it is expected that the bonds will be sold by Jan. 1.

WHARF WORK.—Ottawa, Ont.—Bids are asked until Dec. 10 for the construction of an additional length to the wharf and the formation of a tidal basin at Rimouski, Que. E. F. E. Roy, Secy. Dept. Pub. Wks.

TELEPHONE PLANT.—St. Joseph, Mo.—A local paper states that the Citizen's Telephone Co. was expected to award contracts last week for the completion of its plant, upon which about $15,000 has been expended. Pres., M. M. Riggs; Secy. and Gen. Man., Geo. A. Moss.

IRONWORK.—Charleston-Kanawha, W. Va.—Bids are asked until Dec. 7 for ironwork for movable dams on Great Kanawha River, as stated in our advertising columns. Addison M. Scott, Asst. Engr.; Col. Peter C. Haines, Baltimore, Md., U. S. Engr. in Charge.

LAKE FRONT IMPROVEMENTS.—Maj. W. L. Marshall, U. S. Engineer Office, has approved plans for lake-front improvements, which call for a bulkhead or seawall about 6,000 ft. long, parallel with the lake front and about halfway between the water front and the breakwater.

STAIRWAY.—Jersey City, N. J.—Bids are asked until Nov. 19 for building a stairway on the line of Laidlaw Ave., between Palisade and Hoboken Aves. The work will include 55 cu. yds. earth excavation, 5 cu. yds. rock excavation, 450 lin. ft. girders, etc. Geo. T. Bouton, Clk. Comrs.

DAM.—Collinsville, Conn.—A press report from Otis, Mass., states that the water power company of this place has matured its plans and will commence work in the spring on a large dam below East Otis, Mass. The proposed reservoir will flood a large territory, including the village of East Otis, and will increase the available water supply for the mills of the Farmington River.

LIGHTHOUSE.—Washington, D. C.—The Baltimore "American" states that the lighthouse board has decided upon plans for the erection of a new lighthouse on the dangerous Diamond Shoal, off Cape Hatteras. It is said that within a few weeks material will be advertised for with which to begin work in the early spring. The new plans contemplate an immense structure, built on the screw-pile idea, with foundations 100 ft. beneath the wave surface, and protected on all sides by hundreds of tons of riprap to prevent damage from the shifting sands. Iron piles will be driven down by a hydraulic pressure until a sound footing is secured, and then the structure for the three keepers will be built on the interior of the skeleton to a height of 165 ft. above water. The structure will cost $1,200,000, and $400,000 is now available. Diamond Shoal extends seven miles out from the land, and is covered with but from 6 to 20 ft. of water. It is marked now by Hatteras Light, standing on shore seven miles from the outer edge of the shoal. The new light will stand on the outer edge of the famous shoal, and will be visible 23 nautical miles.

CONTRACT PRICES.

DIKE WORK.—Philadelphia, Pa.—The following bids were received by Maj. C. W. Raymond, U. S. Engineer Office, Nov. 1, for constructing a brush and stone dike, near Liston Point, and repairing the stone dike at Reedy Island, as advertised in Engineering News. The Liston Point dike will commence at a point on the Delaware shore, about 1¼ miles above Liston Point, and extend up stream about 11,600 ft. The Reedy Island dike, the top of which is now 3 to 4 ft. below mean low water, is to be raised over its entire length of 6,300 ft. to the height of 1 ft. above mean low water. In the table (1) is price per cubic yard for 17,000 cu. yds. of brush mattress; (2), price per ton for 58,000 tons of stone for work near Liston Point; (3), price per ton for 24,000 tons of stone at Reedy Island:

Bidder.	1.	2.	3.	Total.
Delaware Const'n Co., Wilmington*	$1.45	$1.35	$1.05	$128,150
I. H. Hathaway & Co., Philadel'a.	1.38	1.38	1.38	136,620
Edward H. Gaynor, Boston.....	1.47	1.37	1.37	137,330
J. A. Bonker, Jersey City, N. J....	1.75	1.55	1.45	154,450
W. H. Flaherty, New York.....	2.00	1.69	1.69	174,110
J. W. Hoffman & Co., Philadelphia	1.15	1.95	1.75	174,650
Geo. W. Andrews, Biddeford, Me..	2.50	4.50	4.00	390,500

* Awarded contract.

PUMPING ENGINE.—Mount Vernon, O.—A press report states that the contract for a 2,000,000-gallon pumping engine has been awarded to the John H. McGowan Co., the bids being as follows:

The John H. McGowan Co., Cincinnati, O.....$2,895
Wilson-Snyder Co., Pittsburg, Pa..... 3,000
Knowles Steam Pump Works, New York..... 3,300
Deane Steam Pump Co., Holyoke, Mass..... 4,636
Laidlaw-Dunn-Gordon Co., Cincinnati....$2,700 and 3,000
Henry R. Worthington, New York.....$3,978 and 3,512

BOILERS.—Newport, Ky.—It is reported that the following bids were received Nov. 4 for a battery of four steam boilers at the water-works: For two 72-in. boilers, 26 6-in. tubes, Hartford insurance plans and specifications, 20 ft. long, set up, stack and furnace complete: Robert Jones & Co., Cincinnati, O., $3,775; Johnson & Golbreth, Cincinnati, O., $3,760; McElvain & Spiegel, Cincinnati, O., $3,680. For two steam boilers, 72-in. diameter, 18 ft. long, and 64 4-in. tubes, set up, with stack and furnace complete: Robert Jones & Co., $2,815; J. K. Rugg & Co., Cincinnati, O., $3,527; McElvain & Spiegel, $2,700; Chandler, Taylor & Co., Indianapolis, Ind., $2,420. John Surran, Supt., writes us that all the bids were rejected, and that an additional appropriation has been petitioned for, after which the work will probably be readvertised.

GATE VALVES.—Boston, Mass.—The "Herald" states that only one bid was received by the water department for a supply of cast iron gate valves, as advertised in daily papers, as follows: J. B. Long, 20-in., $165 each; 24-in., $195; 30-in., $300; 36-in., $485; total, $6,903.

STREET SIGNS.—Hartford, Conn.—The "Times" states that the street commissioners have contracted with the Berlin Iron Bridge Co. for about 1,500 galvanized iron street signs, which will be 3 ins. high with a steel and black enamel background, and will cost 50 cts. each.

RAILWAY WORK.—National City, Cal.—H. N. Savage, Ch. Engr. National City & Otay Ry., writes us that J. C. Long has been awarded the contract for the earthwork for the relocated portion of the main line which was washed away by high water last January, about two miles in length, and for the one-mile extension to the new Tia Juana town (international boundary). The bids were as follows, the price being per cubic yard:

	Div. I. Excavation.	Div. I. Excess embankment.	Div. II. Excavation.	Div. II. Excess embankment.
J. S. Nickerson..	$0.25	$0.15	$0.15	$0.12½
R. S. Smith.....	0.24	0.13	0.24	0.14
Hawkins & Co..	0.15	0.15	0.13	0.13
A. W. Schnell....		....	0.20	0.20
J. C. Long et al..	0.19	0.11	0.15	0.10½

METAL MARKET PRICES.

LEAD.—New York: 3.2 to 3.3 cts. Chicago: 3.07 to 3.1 cts. St. Louis: 3 to 3.05 cts.

BARB WIRE.—Pittsburg: $2.70 and $2.80 for galvanized, and $2.30 and $2.40 for painted in carload and less than carload lots at mill.

FOUNDRY AND PIG IRON.—New York: $12.50 to $14.50. Pittsburg: $12.75 to $15. Chicago: $13 to $15.50.

TRACK MATERIAL.—New York: angle bars, 1.45 to 1.5 cts.; spikes, 1.8 to 1.85 cts.; track bolts, 2.15 to 2.25 cts. with square, and 2.25 to 2.4 cts. with hexagon nuts. Chicago: angle bars, 1.65 to 1.8 cts.; spikes, 1.9 to 2 cts.; track bolts, 2.25 to 2.3 cts. with square and 2.45 to 2.5 cts. with hexagon nuts.

NAILS.—Pittsburg: $2.25 per keg for carload lots and $2.35 for less than carload lots, at mill; $2 and $2.05 for cut nails at mill. Chicago: $2.35 and $2.45 for wire nails, $2.17 and $2.25 for cut nails. New York: $2.3 and $2.4 for wire nails, and $2.28 and $2.3 for cut nails.

RAILS.—New York: $28 at eastern mills and $28.75 at tidewater; old rails, $15 to $16 for iron, and $18 to $13.50 for steel; light rails, $29; girder rails, $26. Pittsburg: $28 for standard sections of 45 lbs. and over; $28 for light sections; old rails, $19.75 for iron and $17 for steel. Chicago: $29 to $31 for standard sections; $28 for light sections; old rails, $17.75 for iron, and $13 to $14 for steel.

STRUCTURAL MATERIAL.—New York: beams, 1.75 to 2.1 cts.; channels, 1.85 to 2 cts.; angles, 1.65 to 1.8 cts.; tees, 1.9 to 2 cts.; universal mill plates, 1.75 to 1.95 cts.; steel plates, 1.75 to 2 cts. for tank, 2 to 2.1 cts. for shell, 2.1 to 2.25 cts. for flange, 2.4 to 2.5 cts. for ordinary firebox, 2.6 to 2.75 for locomotive firebox. Pittsburg: beams, 1.6 to 1.9 cts.; channels, 1.6 to 1.9 cts.; angles, 1.5 to 1.6 cts.; tees, 1.6 to 1.65 cts.; Z-bars, 1.6 to 1.65 cts.; universal mill plates, 1.8 to 1.9 cts.; steel plates, 1.7 to 1.75 cts. for tank, 1.8 to 1.85 cts. for shell, 1.9 to 1.95 cts. for flange, 2.5 cts. for ordinary firebox, 2.5 to 4 cts. for locomotive firebox. Chicago: beams, 1.8 to 1.9 cts.; channels, 1.8 to 1.9 cts.; angles, 1.75 to 1.85 cts.; tees, 1.95 to 2 cts.; universal mill plates, 1.95 to 2.05 cts.; steel plates, 1.95 to 2.05 cts. for tank, 2.25 to 2.35 cts. for flange, 2.8 to 2.9 cts. for ordinary firebox, 4 to 4.5 cts. for locomotive firebox.

CONDITION OF MARKETS.—The New York "Journal of Commerce" states that in iron and steel the general situation is unchanged. Foundry men and mill men, while not securing many orders, are comfortably well employed, and the prospects are that they will continue to be during the balance of the year. Only moderate purchases of crude material are being made, however, since liberal supplies are either on hand or under engagement. The steel rail business continues to be remarkably light in this quarter, and orders for other finished products are moderate. There has been no further movement in the pig lead market. Western smelters offered less freely, but more common lead came out at 3.2 cts. than the market would absorb. In fact, single carloads could have been purchased at that price for early shipment. Dealings in copper are on a very moderate scale, and there is little demand from any quarter. Jobbers seem to have quite enough stock to meet the small orders coming to hand, and speculators a quantity that suffices to keep the surface of the market ruffled. Lake producers are reserved in their offering, and there is no great amount of electrolytic on offer by smelters. Casting stock, however, seems to be in less enviable position. The nominal prices are 11½ cts. for Lake Superior ingot, 11 to 11¼ cts. for electrolytic and 10½ to 10⅝ cts. for casting. The manufacturers have raised prices of sheathing and bolt copper 1 ct. per lb., and now quote on the basis of 16 cts. for standard sizes. In tin-plate no improvement has been noted, nor is the demand any better. In fact, buyers seem exceedingly partial to the hand-to-mouth policy in all operations. Prices have undergone no decided change, but seem rather weak.

INDUSTRIAL NOTES.

THE SHEFFIELD COAL, IRON & STEEL CO., of Sheffield, Ala., is preparing to start one of its furnaces.

THE CROWN FIRE CLAY CO., of Canal Dover, O., has increased its capital stock from $100,000 to $200,000.

MILLER, JACKSON & CARNEY, Shelby, N. C., are building an extensive foundry and machine shop at that place.

THE WELLS & FRENCH CO., of Chicago, Ill., car builders, are said to be erecting additional works, at a cost of $150,000.

THE MILLER GAS ENGINE CO., of Urbana, O., is to remove to Springfield, and expects to be in its new quarters by Nov. 15.

NIEDRINGHAUR BROS., of Edwardsville, Ill., re-

cently issued a mortgage of $300,000, for the purpose of improving and enlarging their plant.

THE TONAWANDA IRON & STEEL CO., of Tonawanda, N. Y., it is stated, expects to have its new stack in operation by Jan. 1.

LOUIS V. SHAW & CO., of Milwaukee, Wis., are planning to add a five-gross-ton open-hearth steel furnace to their crucible plant.

THE MARINE IRON WORKS, of Chicago, Ill., has sold to the Chautauqua Lake Steamboat Co., Jamestown, N. Y., two steam yachts.

THE ANDREW & HITCHCOCK IRON CO., of Youngstown, O., will soon put in blast its No. 2 stack, which has been idle for the past year.

THE STICKNEY IRON CO., of Canton, Md., has nearly completed its new tin plate plant, and expects to be ready for operation this month.

THE LAIDLAW-DUNN-GORDON CO., of Cincinnati, O., will furnish the Elizabeth (Pa.) Water Co. with a pump of 1,000,000 gallons daily capacity.

THE ARCHITECTURAL IRON CO., of Canonsburg, Pa., has been closed on a judgment of $17,000 in favor of the Baird Machinery Co., of Pittsburg.

THE ELLIOTT CAR WORKS, of Gadsden, Ala., has recently received an order for 200 new cars, and has had to increase the number of its employees.

SEYFORT & BROTHER, of Seyfort, Berks county, Pa., recently resumed operations, after an idleness of several years, and will employ about 250 hands.

ANDERSON, DU PAY & CO., of McKee's Rock, Pa., have erected an addition to their plant for the manufacture of tools for railway shops and railway work.

THE PITTSBURG WIRE CO., of Pittsburg, Pa., recently increased its capital stock to $300,000, and will improve its plant and give employment to 600 hands.

THE SUNBURY IRON WORKS, at Sunbury, Pa., which have been idle for several years, were recently sold, and will resume operations under new management.

THE POTTSVILLE IRON & STEEL CO., of Pottsville, Pa., has the contract for furnishing $150,000 worth of structural iron for the new Baltimore court house.

THE FOUNDRY OUTFITTING CO., of Detroit, Mich., has closed a contract for a full equipment for the new foundry of the Le Baron Foundry Co., of Middleborough, Mass.

THE NEWMAN WIRE TRUSS FENCE CO., of Victor, N. Y., has the contract for the fencing on the Toronto, Hamilton & Buffalo R. R. About 90 miles of fence will be built.

THE H. C. FRICK CO., of Pittsburg, Pa., has again added to its plant by purchasing the mines and plant owned by W. J. Rainey & Co., the third largest in the Connellsville region.

THE T. T. HAYDOCK CARRIAGE CO., of Cincinnati, O., recently received the contract to build a carriage for the Sultan of Turkey; also an order from Cape Town, South Africa.

THE OTTO GAS ENGINE WORKS, of Philadelphia, Pa., was recently awarded a contract for a 20-HP. gasoline engine for a plant being built by W. A. Clark, at New Wilmington, Pa.

H. WALES LINES CO., of New Britain, Conn., has let the contract for the erection of a large brick mill adjoining its plant, 139 × 51 ft., and four stories high. Work will begin at once.

THE BIGELOW CO., of New Haven, Conn., is constructing 10 large Manning boilers for the City Mfg. Corporation, of New Bedford, Mass. The boilers are 16 ft. high and 6 ft. in diameter.

THE J. I. CASE MFG. CO., of Racine, Wis., was recently forced to close its plant, owing to the low water in Root River. Other arrangements will be made for water if the low water continues.

THE ANDERSON FOUNDRY & MACHINE WORKS, of Anderson, Ind., has received an order from the Follansbee Brothers Co., of Pittsburg, Pa., for two single-tinning machines, which will be specially built for their use.

THE MONTANA COAL & COKE CO., at Horr, near Livingston, Mont., will spend $300,000 in improvements during the winter; it is stated that 100 coke ovens will be constructed and the output of coal from the mines largely increased.

THE KLOTS THROWING CO., of Carbondale, Pa., is locating two double-nozzle fire hydrants, having 6-in. valve openings, on either side of its mill. The erection of machinery will begin at an early date. The boilers are already in place.

THE SAN ANTONIO SEWER PIPE & MFG. CO., of Calaveras, Wilson county, Tex., is busy constructing its factory. The latest improved machinery will be introduced. Already more than $50,000 has been expended on the plant.

THE CALUMET FURNACE CO., of South Chicago, Ill., lessees of the blast furnace of the Calumet Iron & Steel Co., has leased the bar and nail mills of the latter company, and put them in active operation. About 800 people will be employed.

THE ASHLAND MFG. CO., of Ashland, O., was recently organized to engage in the manufacture of pumps. The company recently placed an order with the Lodge & Davis Tool Co., of Cincinnati, O., for lathes, planers, drills and other tools.

THE JACKSON & SHARP CO., of Wilmington, Del., will build for parties in Anglesea, N. J., a fishing steamer 85 ft. long, 20 ft. beam and 7 ft. depth of hold. It is reported that Neafie & Levy, of Philadelphia, will furnish the machinery.

THE HASKELL & BARKER CAR CO., of Michigan City, Ind., has an order for 1,000 cars for the Illinois Central R. R. A report states that this order was tendered to the Pullman Co., which was obliged to decline it on account of pressure of other work.

THE CARBON STEEL CO., of Pittsburg, Pa., recently completed the plates for the boilers of a new steam yacht being built for Pittsburg parties. The steel used was 1.28 ins. thick. The company also has the contract for the hull plates of the boat.

CRELLIN & LOVELL, Des Moines, Ia., now have the contracts on hand for putting in complete waterworks plants at Armstrong, Ia.; Waukon, Ia.; Postville, Ia. They have also been engaged to prepare plans and specifications for water-works at Elgin, Ia.

THE POST, JACOBI & BRUNING CO., Lakeside Bldg., Chicago, has recently had constructed, from its own design, a machine for manufacturing blueprint process paper with a capacity of 5,000 yds. daily. Blueprints can be made on cloudy days as well as on clear days.

THE METALLIC EXTRACTION CO., of Florence, Colo., will build another 150-ton cyanide plant. Supt. Argall announces that work will begin at once on the new mill, and states that the company cannot at present take care of more than half the ore offered it.

THE LEHIGH VALLEY R. R. recently awarded the following contracts: Baldwin Locomotive Works, of Pittsburg, Pa., 50 locomotives; United States Car Co., Chicago, Ill., 1,000 box cars; Buffalo Car Co., Buffalo, N. Y., 500 box cars, and Union Car Co., Depew, N. Y., 500 box cars.

BENSEL & CO., of Atlanta, Ga., have been awarded the contract for building the Dixie cotton mills at La Grange, Ga. Work has already commenced, and the company will push the work to an early completion, being under contract to turn the mill over to the owners on March 1.

THE FULTON STEAM BOILER WORKS, of Richmond, Ind., recently received orders for 10 carloads of boilers for the Diamond Paper Co., of Anderson, Ind.; six carloads for the Indiana Pulp & Paper Co., of Marion, Ind., and two carloads for the Urbana (O.) Water-Works Co.

THE COX COMPUTER CO., of Stapleton, N. Y., has been incorporated, with ample capital, to undertake the manufacture and sale of the various computers designed by Mr. Wm. Cox for the flow of gas and water in pipes, strength of beams, etc. The price has been reduced one-half in most cases. Mr. Wm. Cox is the President.

THE ARCHMAN STEEL CASTING CO., of Sharon, Pa., has commenced operations at its new plant, which consists of a main building, 55 × 170 ft., with a wing 34 × 40 ft.; molding room, 40 × 60 ft.; machine shop, 30 × 60 ft., sand house, etc. This gives the company a ground floor equal to three times what it possessed before the fire in June, 1894.

THE HALL STEAM PUMP CO., of Allegheny, Pa., has completed two duplex pressure pumps, one to have 28-in. steam cylinders, 7-in. plungers, 24-in. stroke, and the other 20-in. steam cylinders, 2½-in. plungers, 18-in. stroke. These pumps will operate a hydraulic cotton compress, compressing bales up to 4,000 lbs. per sq. in., and are made for parties in Texas.

NEW BRIDGE WORKS.—According to the Philadelphia "Times," a structural iron and bridge company will locate its plant at Royersford, near Norristown, Pa. The company has filed an application for a charter and has purchased four acres of ground on which to erect its plant. David Springer, D. L. Hallman and George Bland, of Philadelphia, are interested.

THE VIRGINIA BRIDGE & IRON CO., of Roanoke, Va., has recently been incorporated, as successor to the American Bridge & Iron Co., of that place. The Chief Engineer is Mr. Chas. C. Wentworth, M. Am. Soc. C. E., who designed the transfer bridge for the Atlantic & Danville R. R., described in our issue of Sept. 19. Pres., Samuel Walton; Secy. and Treas., C. Edwin Michael.

THE HARVEY BOILER WORKS, of Harvey, Ill., has undergone a change of management, and Mr. Chas. McElhowney is now the proprietor. In the stand-pipe department a 24 × 100-ft. tank is being made for the Mt. Pulaski, Ill., water-works, and 12 × 100-ft. standpipes for Fowler and Crown Point, Ind. The company is also getting out several boilers for the American Boiler Co., Chicago.

THE ELECTRIC STORAGE BATTERY CO., of Philadelphia, Pa., recently absorbed the Pumpelly-Sorley Storage Battery Co., of Chicago, Ill., the consideration being $100,000. The Electric Storage Battery Co. now has a practical monopoly of the storage battery patents and business of the United States, and has recently acquired the right to use the Tudor battery in this country.

THE SCRANTON ELECTRIC CONSTRUCTION CO., of Scranton, Pa., has had several of its electric locomotives in operation at various mines, for hauling coal, where they have proved reliable and efficient. The engines placed in the mines of O. S. Johnson, at Green Ridge, Pa., and New York & Scranton Coal Co., at Peckville, Pa., have been in successful operation over eight months.

THE BERLIN IRON BRIDGE CO., of East Berlin, Conn., has just completed for the Somerville Woolen mills, at Somerville, N. J., a spinning room, 54 × 210 ft. and a boiler room, 40 × 216 ft. The construction of the spinning room is steel trusses, with heavy plank floors and roof. The boiler room is constructed with brick walls, steel trusses and corrugated steel covering, making it fireproof.

SUBMARINE PIPE JOINTS.—Frank Rann, 138 East Kinzie St., Chicago, is putting on the market the submarine pipe joint which was used on the 10,000 ft. of 60-in. water-works intake main, at Milwaukee, Wis., and was illustrated on the inset sheet in the article describing that work in Engineering News of Sept. 19, 1895. This joint has also been used on 5,000 ft. of 24-in. water-works intake at Kenosha, Wis.

THE RIEHLE BROS. TESTING MACHINE CO., of Philadelphia, Pa., has a 100,000-lb. automatic and autographic testing machine at the international exposition, Atlanta, Ga. This machine forms a part of the government exhibit, and is in the Minerals and Forestry Building, where any one interested can see it in operation, as tests are being made during the day, and the machine is attracting considerable attention.

THE F. L. SMITH CO., of Jersey City, N. J., which was recently formed, with a capital stock of $50,000, will act in the capacity of consulting and contracting engineers, and will buy and sell chalk, moss-litter, heiselgahr, infusorial earth and other natural products.

Paul Larsen, Copenhagen, Denmark; George M. Newcomer, Richmond Hill, L. I., N. Y.; Stephen G. Williams, Somerset county, N. J., and John J. Griffin, New York city, are the incorporators.

THE MOUNT VERNON CAR MFG. CO., of Mount Vernon, Ill., has recently been awarded contracts for box cars for the Pennsylvania and the Chicago & Eastern Illinois railways; refrigerator cars for the Piant system, and coal cars for the Mexican Central Ry. W. C. Arthurs, Secy. and Treas., reports a decided improvement in business, and that the company is now completing orders for coal cars for the Louisville & Nashville, and the Cleveland, Lorain & Wheeling railways.

THE ROACH SHIPBUILDING CO., of Chester, Pa., has under construction seven steel vessels, and is employing nearly 1,000 men. No. 281 is a fast freight propeller for the Delaware river trade; No. 282 is a 150-ft. pleasure yacht; No. 283 is a pleasure yacht of nearly the same size; Nos. 284 and 285 are large freight propellers for the New London Steamship Co., and will be 282 ft. long and among the best-equipped freight steamers; Nos. 286 and 287 are steel barges for the Panama Railroad Co.

THE GOLD CAR HEATING CO., LTD., with principal office at St. John, N. B., is the name of a new company which is being organized, with a capital stock of $250,000, the object being to purchase all patent rights of the Gold Heating Co., of the city of New York, for the Dominion of Canada, etc., and also the manufacture of heating apparatus of all descriptions. Russell Sage, 71 Broadway; Edward E. Gould, 195 Broadway; Frank J. Menzie, all of New York city; and Hugh H. McLean, of St. John, N. B., are interested.

JAMES STEWART & CO., of St. Louis, Mo., have a number of large contracts for various classes of buildings, among others being the following: Warehouses and elevators for the Port Chalmette Cotton Compress buildings, at New Orleans, La.; a 10,000-bu. distillery for the Indiana Distilling Co., Terre Haute, Ind.; also a contract for doubling the capacity of the cattle barns for the same company; an 85,000-spindle mill for the Berkshire Cotton Co., North Adams, Mass., and a large number of smaller factory and warehouse buildings in various parts of the country. The aggregate cost of contract work carried to successful completion by this firm in 1894 was $1,500,000, and Mr. J. C. Stewart states that this year's record will be higher than that of any previous year.

GEO. P. NICHOLS & BRO., of Chicago, have been awarded the contract for equipping with operating and controlling machinery the draw-span of the new bridge being built over the Mississippi River, between Rock Island, Ill., and Davenport, Ia., by the U. S. government. Electricity will be used as motive power, and the end jacks and rail-joint mechanisms will be operated by compressed air, an electrically-driven air-compressor located in the operator's house furnishing the necessary pressure. The entire system of control, from the track signals on the fixed spans to the driving machinery, is made interlocking, thus assuring safety to traffic and to the bridge itself. Among other bridges equipped by this firm are: The Van Buren St. rolling lift bridge in Chicago, and the Columbus St. double-swing bridge in Cleveland, O., both of which have been fully described in Engineering News.

NEW COMPANIES.—The Piedmont Cotton Mill Co., Atlanta, Ga.; $200,000; Pres., R. W. Hardemann.

Albany Reduction Co., Albany, N. Y.; $150,000; J. H. Brooks, John Wagner, John F. Farrell and others, of Albany.

H. H. Lane Mfg. Co., Huntingdon, Pa.; to manufacture iron and steel, pipes, etc.; $25,000, with $2,500 paid in.

The Standard Brass & Electric Co., St. Paul, Minn.; $50,000; Jehiel W. Jaggar, Jacob Hellbron and Theodore Grutting.

Chicopee Gas Co., Chicopee, Mass.; $40,000; Pres., J. Howard Nichols, Boston, Mass.; Treas., C. H. Nutting, Chicopee, Mass.

J. C. Dana Co., Sturgeon Bay, Wis.; to deal in machinery; $20,000; John M. Koch, Thomas Gillespie and Joseph C. Dana.

Result of a FURNITURE Advertisement.

Fairfax, Va., Nov. 12, 1895.

Engineering News Publishing Co.,
New York City.

Gentlemen: Enclosed find check for our advertisement for furnishing the new county and circuit court clerk's offices with the necessary furniture and fixtures. The publication of this in Engineering News brought me about 15 letters and 3 bids. We feel that the advertisement paid us.

Yours truly,
F. W. Richardson, County Clerk.

(We have received hundreds of letters showing that our water-works, sewer, paving, electric light, public building, railway, etc., advertisements produce extensive competition from reliable contractors, and that a short advertisement in this paper is positively the most efficient as well as the most economical method of securing desirable competition for supplies or construction. The letter printed above is additional evidence that contract work of all kinds should be advertised in Engineering News, and that it always pays to advertise work in this paper.—Ed.)

Contract Work should always be advertised in Engineering News.

The Circulation of Engineering News among Prominent Contractors and Contractors' Supply Men Probably Exceeds that of Any Other Five Papers in America.

ADVERTISE YOUR WORK WHERE IT IS GIVEN THE GREATEST POSSIBLE PUBLICITY.